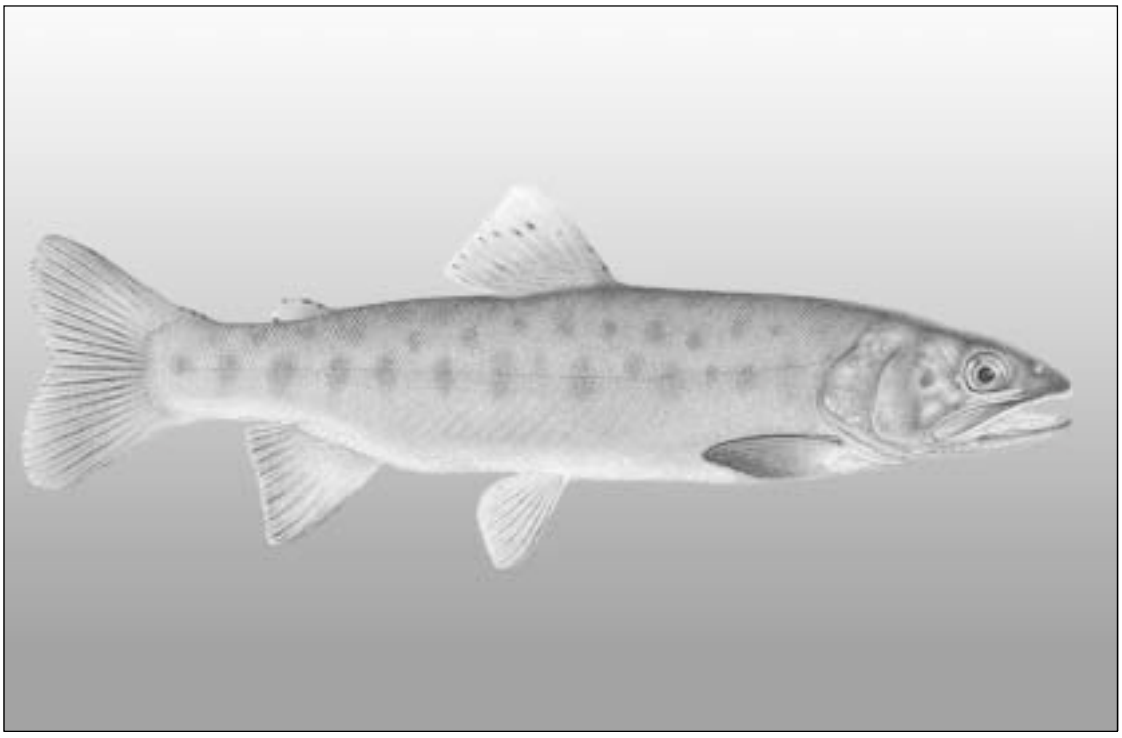
Draft Revised Recovery Plan for the Paiute Cutthroat Trout

(Oncorhynchus clarki seleniris)



DRAFT REVISED RECOVERY PLAN

FOR THE

PAIUTE CUTTHROAT TROUT

(*Oncorhynchus clarki seleniris*)

Original Approved: January 25, 1985

(November 2003)

Region 1
U. S. Fish and Wildlife Service
Portland, Oregon

Approved: XXXXXXXXXXXXXXXXXXXXXXXXX
Manager, California/Nevada Operations Office

Date: _____

DISCLAIMER

Recovery plans delineate reasonable actions that are believed to be required to recover and/or protect listed species. We, the U.S. Fish and Wildlife Service, publish recovery plans, sometimes preparing them with the assistance of recovery teams, contractors, State agencies, and other affected and interested parties. Objectives of the recovery plan will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not obligate other parties to undertake specific tasks and may not represent the views nor the official positions or approval of any individuals or agencies involved in recovery plan formulation, other than our own. They represent our official position *only* after they have been signed by the California/Nevada Operations Manager, Regional Director, or Director as *approved*. Recovery plans are reviewed by the public and submitted to additional peer review before we adopt them as approved final documents. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery actions.

LITERATURE CITATION SHOULD READ AS FOLLOWS:

U.S. Fish and Wildlife Service. 2003. Draft Revised Recovery Plan for the Paiute cutthroat trout (*Oncorhynchus clarki seleniris*). Portland, Oregon. x + 84 pp.

An electronic version of this recovery plan will also be made available at http:/pacific.fws.gov/ecoservices/endangered/recovery/default.htm and http://endangered.fws.gov/recovery/index.html.

ACKNOWLEDGMENTS

We gratefully acknowledge the commitment and efforts of the following individuals to the recovery of the Paiute cutthroat trout. Without their assistance, this revision would not have been possible.

Dawne Becker, California Department of Fish and Game

Brian Finlayson, California Department of Fish and Game

Eric Gerstung, California Department of Fish and Game

Jim Harvey, U.S. Forest Service, Humboldt-Toiyabe National Forest

Stafford Lehr, California Department of Fish and Game

Lisa Sims, U.S. Forest Service, Inyo National Forest

Pat Shanley, U.S. Forest Service, Humboldt-Toiyabe National Forest

William Somer, California Department of Fish and Game

Stan Stephens, California Department of Fish and Game

Phil Strand, U.S. Forest Service, Sierra National Forest

Darrell Wong, California Department of Fish and Game

EXECUTIVE SUMMARY

Background: The Silver King Creek drainage is located on the eastern slope of the Sierra Nevada Range, in Alpine County, California. It is a major tributary to the East Fork of the Carson River, which drains into the Lahontan Basin. It provides habitat for one fish species, Paiute cutthroat trout (*Oncorhynchus clarki seleniris*), that is listed as threatened under the Endangered Species Act of 1973, as amended. It also provides known or potential habitat for two amphibian candidate species, the Sierra Nevada population of the mountain yellow-legged frog (*Rana muscosa*) and the Yosemite toad (*Bufo canorus*). All Paiute cutthroat trout recovery actions were evaluated to minimize adverse impacts to the frog and toad.

Current Species Status: The Paiute cutthroat trout was listed as endangered on October 13, 1970 (U.S. Fish and Wildlife Service 1970) and subsequently reclassified to threatened on July 16, 1975 (U.S. Fish and Wildlife Service 1975) to facilitate management and allow regulated angling. It occupies approximately 18.6 kilometers (11.5 miles) of historically fishless stream habitat in the Silver King drainage above Llewellyn Falls and above a barrier in Corral and Coyote Creeks (Figure 1). Four self-sustaining, genetically pure populations of Paiute cutthroat trout are known to occur out-of-basin in the North Fork of Cottonwood Creek, Stairway Creek, Sharktooth Creek, and Cabin Creek (Figures 2 and 3).

Recovery Priority: The Paiute cutthroat trout has a recovery priority number of 9, per criteria published by a Federal Register notice in 1983 (U.S. Fish and Wildlife Service 1983). This priority number indicates a subspecies with moderate degree of threat and a high potential for recovery.

Habitat requirements: The life history and habitat requirements for Paiute cutthroat trout are similar to those reported for other western stream-dwelling salmonids. All life stages require cool, well-oxygenated waters. Adult fish prefer stream pool habitat in low gradient meadows with undercut or overhanging banks and abundant riparian vegetation. Paiute cutthroat trout can survive in lakes, but there is no evidence that they ever occurred naturally in any of the lakes within the Silver King basin. To spawn successfully, they must have access to flowing waters with clean gravel substrates.

Recovery Goal: Recovery of Paiute cutthroat trout sufficient to allow delisting of the species.

Recovery Objectives: Improve the status and habitat of Paiute cutthroat trout and eliminate competition from nonnative salmonid species.

Recovery Criteria: Paiute cutthroat trout will be considered for delisting when the following objectives are met:

1) All nonnative salmonids are removed in Silver King Creek and its tributaries downstream of Llewellyn Falls to fish barriers in Silver King Canyon;

2) A viable population occupies all historic habitat in Silver King Creek and its tributaries downstream of Llewellyn Falls to fish barriers in Silver King Canyon;

3) Paiute cutthroat trout habitat is maintained in all occupied streams; and

4) The refuge populations in Corral and Coyote Creeks, Silver King Creek, and tributaries above Llewellyn Falls as well as out-of-basin populations are maintained as refugia and are secured from the introduction of other salmonid species.

5) A long-term conservation plan and conservation agreement are developed, which will be the guiding management documents once Paiute cutthroat trout are delisted.

Recovery Actions:

1. Remove nonnative trout from historic Paiute cutthroat trout habitat.
2. Reintroduce Paiute cutthroat trout into historic habitat.
3. Protect and enhance all occupied Paiute cutthroat trout habitat.
4. Continue to monitor and manage existing and reintroduced populations.
5 Develop a long-term conservation plan and conservation agreement.
6. Provide public information.

Implementation Participants: The California Department of Fish and Game and the U.S. Forest Service will assist the U.S. Fish and Wildlife Service in implementing recovery tasks.

Total Estimated Cost of Recovery ($1,000's):

Year	Action 1	Action 2	Action 3	Action 4	Action 5	Action 6
2004	38	--	2	19.73	--	2.9
2005	31	--	49.5	31.23	--	2.9
2006	31	--	51.1	38.31	--	2.9
2007	--	8	37	20.73	--	2.9
2008	--	8	4.08	20.73	--	0.4
2009	--	8	3.6	23.81	--	--
2010	--	8	2	20.73	6	--
2011	--	8	2	20.73	6	--
2012	--	--	3.6	20.81	--	--
2013	--	--	4.08	18.73	--	--
TOTAL	100	40	158.95	235.5	12	12

The total estimated cost of recovering Paiute cutthroat trout is $558,450, plus additional costs that cannot be estimated at this time.

Date of Recovery: Delisting of the Paiute cutthroat trout could be initiated in 2013, if tasks are implemented as recommended and recovery criteria are met.

TABLE OF CONTENTS

I. INTRODUCTION 1
A. Brief Overview 1
B. Species Description 5
C. Associated Candidate Species 6
1. Sierra Nevada Population of Mountain Yellow-legged Frog . . 6
2. Yosemite Toad 8
D. Life History and Habitat Requirements 10
E. Distribution 12
F. Abundance 19
1. Silver King Creek Drainage 19
2. North Fork of Cottonwood Creek 23
3. Cabin Creek 24
4. Stairway Creek 25
5. Sharktooth Creek 25
G. Habitat Description 26
1. Silver King Creek Drainage 26
2. North Fork of Cottonwood Creek 32
3. Cabin Creek 34
4. Stairway Creek 35
5. Sharktooth Creek 35
H. Reasons for Listing and Current Threats 40
I. Conservation Efforts 44

II. RECOVERY 48
A. Objective and Criteria 48
B. Recovery Strategy 49
C. Narrative Outline of Recovery Actions 51

III. IMPLEMENTATION SCHEDULE 63

IV. REFERENCES 71
A. Literature Cited 71

B. *In Litt.* References 77
C. Personal Communications 77

APPENDIX A. Summary of General Aquatic Wildlife System (GAWS) Survey Locations, Sediment Sampling, and Macroinvertebrate Sampling A-1

APPENDIX B. Summary of Threats and Recommended Recovery Actions B-1

LIST OF TABLES

Table 1. Recorded Transplants of Paiute Cutthroat Trout 16

Table 2. Physical Characteristics of Silver King Creek and its Principal Tributaries. 28

Table 3. Summary of Habitat Condition Index (HCI) Ratings from 1984, 1987, and 1990 30

Table 4. Common and scientific names of the riparian plant communities in the Silver King Creek drainage 32

Table 5. Summary of Habitat Survey on Stairway Creek Conducted in 1996. 36

Table 6. Cross Sectional Data From 2000 Survey of Stairway Creek 36

Table 7. Transect Data From 2000 Survey of Stairway Creek 37

Table 8. Cross Sectional Data From 1999 Survey of Sharktooth Creek . . 39

Table 9. Transect Data From 1999 Survey of Sharktooth Creek 39

Table A1. Summary of GAWS station site characteristics A-1

Table A2. Summary of sediment samples collected in 1984 and 1990 . . A-2

Table A3. Summary of macroinvertebrate diversity index (DAT) ratings from 1984, 1987, and 1990 . . . . . A-3

Table A4. Summary of macroinvertebrate standing crop data from 1984, 1987, and 1990 . . . . . A-4

Table A5. Summary of macroinvertebrate Biotic Condition Index (BCI) ratings from 1984, 1987, and 1990 . . . . . A-5

Table B1. Summary of Threats and Recommended Recovery Actions . . . B-1

LIST OF FIGURES

Figure 1. Silver King Creek and its tributaries, Humboldt-Toiyabe National Forest, Alpine County, California 4

Figure 2. North Fork Cottonwood Creek and Cabin Creek, Inyo National Forest, Mono County, California. 17

Figure 3. Stairway Creek, Madera County and Sharktooth Creek, Fresno County, California, Sierra National Forest. 18

Figure 4. Historical population estimates (1964 to 2001) from the Upper Fish Valley reach of Silver King Creek. 20

Figure 5. Historical population estimates (1964 to 2000) from Four Mile Creek. 20

Figure 6. Historical population estimates (1984 to 2000) from Fly Valley Creek. 21

Figure 7. Historical population estimates (1974 to 2000) from Corral Valley Creek.. 21

Figure 8. Historical population estimates (1984 to 2000) from Coyote Valley Creek 22

Figure 9. Visual observations from the North Fork of Cottonwood Creek since 1989. 24

Figure A1. Location of GAWS stations on Silver King, Four Mile Canyon, Fly Valley, and Bull Canyon Creeks A-6

Figure A2. Locations of GAWS stations on Corral Valley and Coyote Valley Creeks A-7

I. INTRODUCTION

A. Brief Overview

The Paiute cutthroat trout (*Oncorhynchus clarki seleniris*) is native to Silver King Creek in the East Fork Carson River drainage on the Humboldt-Toiyabe National Forest, Alpine County, California. This basin also provides known or potential habitat for two amphibian candidate species, the Sierra Nevada population of the mountain yellow legged frog (*Rana muscosa*) and the Yosemite toad (*Bufo canorus*). Paiute cutthroat trout evolved in isolation from other fish species in this headwater tributary of the Lahontan Basin.

The Paiute cutthroat trout was federally listed as endangered on October 13, 1970 (U.S. Fish and Wildlife Service 1970) and subsequently reclassified to threatened on July 16, 1975 (U.S. Fish and Wildlife Service 1975) to facilitate management and allow regulated angling. Critical habitat has not been designated for this species. The historical distribution of Paiute cutthroat trout is thought to have been limited to Silver King Creek and its tributaries below an impassable barrier (Llewellyn Falls) to downstream barriers located in Silver King Canyon. In the early part of the twentieth century they were eliminated from their presumed historic habitat through hybridization with introduced rainbow trout (*Oncorhynchus mykiss*), golden trout (*Oncorhynchus mykiss aguabonita*), and Lahontan cutthroat trout (*Oncorhynchus clarki henshawi*). Their range was extended into the upper reaches of Silver King Creek and its tributaries by one or more unofficial transplants of fish above Llewellyn Falls starting in 1912.

The current distribution of Paiute cutthroat trout within the Silver King Creek drainage is the upper reaches of Silver King Creek and its tributaries above Llewellyn Falls, and Corral Valley and Coyote Valley Creeks below Llewellyn Falls. The progeny of these early day transplants have been introduced into several other lakes and streams in California and at least four self-sustaining populations have become established outside the historic drainage. The four out-of-basin populations occur in the North Fork of Cottonwood Creek and Cabin Creek (Inyo National Forest, Mono County, California), Sharktooth Creek (Sierra

National Forest, Fresno County, California) and Stairway Creek (Sierra National Forest, Madera County, California). To prevent the extinction of this fish and to attain its recovery, all viable extant populations must be maintained and secured, nonnative fish must be removed from historic habitat, and Paiute cutthroat trout must be successfully reintroduced into Silver King Creek from Llewellyn Falls downstream to Silver King Canyon.

A recovery plan for the Paiute cutthroat trout was prepared in 1985 (U.S. Fish and Wildlife Service 1985). The objectives of the 1985 recovery plan were to reestablish a pure population of Paiute cutthroat trout in Silver King Creek above Llewellyn Falls, and secure and maintain the integrity of the occupied habitats in Silver King Creek, North Fork Cottonwood Creek, and Stairway Creek, all which occur outside of the presumed historic habitat. The 1985 recovery plan did not address recovering Paiute cutthroat in its historic habitat because it was not known that natural barriers existed which would prevent upstream migration of non-native salmonids into historic habitat. This revised recovery plan will incorporate recent research data and address the species' current status, threats, distribution, and recovery needs. It also addresses the effects of recovery actions on mountain yellow-legged frog and Yosemite toad, which occur within the Silver King Creek drainage and at the sites of the out-of-basin populations. All Paiute cutthroat trout recovery actions have been evaluated to minimize adverse impacts to the frog and toad. In keeping with our current policy (U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration 1994), this recovery plan identifies tasks to maintain ecosystem integrity as well as recover the listed species.

Based on new information and completed tasks, we have determined it is necessary to revise recovery criteria and tasks within the 1985 Paiute cutthroat trout recovery plan. The new information and completed tasks include: 1) the discovery of fish barriers downstream of Llewellyn Falls that would enable the expansion of Paiute cutthroat trout into historic habitat, 2) elimination and reduction of threats to existing populations, 3) increased knowledge about Paiute cutthroat trout population dynamics based on long-term trend data, and 4) information about the current status of out-of-basin populations based on recent population estimates.

The extremely limited native range of the Paiute cutthroat trout, approximately 14.7 kilometers (9.1 miles) of stream habitat within a single watershed (Figure 1), is the primary factor in identifying recovery tasks. Potential recovery activities within the native range include the reintroduction of Paiute cutthroat trout downstream from Llewellyn Falls to Silver King Canyon once nonnative fish have been removed, and the protection of stream habitat in the Silver King Creek watershed. If the Paiute cutthroat trout occurred only in its currently occupied habitat, it would be highly vulnerable to extinction because: 1) genetic diversity could be dramatically reduced by a catastrophic event within any of the five drainages it currently occupies; 2) populations could become quickly introgressed (lose their distinctiveness due to introduction of genes from another population into the gene pool) as the result of an unauthorized introduction of other salmonids; and 3) genetic diversity could be subjected to additional severe bottlenecks due to inadequate population size. However, reintroduction of Paiute cutthroat trout to historical habitat, in combination with populations existing upstream of Llewellyn Falls and out-of-basin, will substantially reduce these extinction threats.

In 2001, 823 individuals were observed in Silver King Creek in Upper Fish Valley. Based upon population estimation models, the population in Upper Fish Valley may be as high as 1,707 individuals. These numbers are within the range of population fluctuation observed since 1964. Population trends in Corral Valley, Four Mile Canyon Creek, Fly Valley, and Coyote Valley Creeks are stable. Estimated population densities based on the 2000 survey for Corral Valley and Four Mile Canyon Creeks are respectively 59 and 78 fish per kilometer (95 and 126 per mile). Fly Valley Creek has an estimated 118 fish per kilometer (190 per mile) based on the 2000 survey. Coyote Valley Creek was split into two sections, upper and lower meadow. During the 2000 survey, 508 fish per kilometer (819 per mile) were estimated for the upper meadow section while 589 fish per kilometer (950 per mile) were estimated for the lower meadow section. Expansion of Paiute cutthroat trout downstream into historical habitat would nearly double the length of occupied habitat in the Silver King drainage from 18.6 kilometers (11.5 miles) to 33.3 kilometers (20.5 miles).

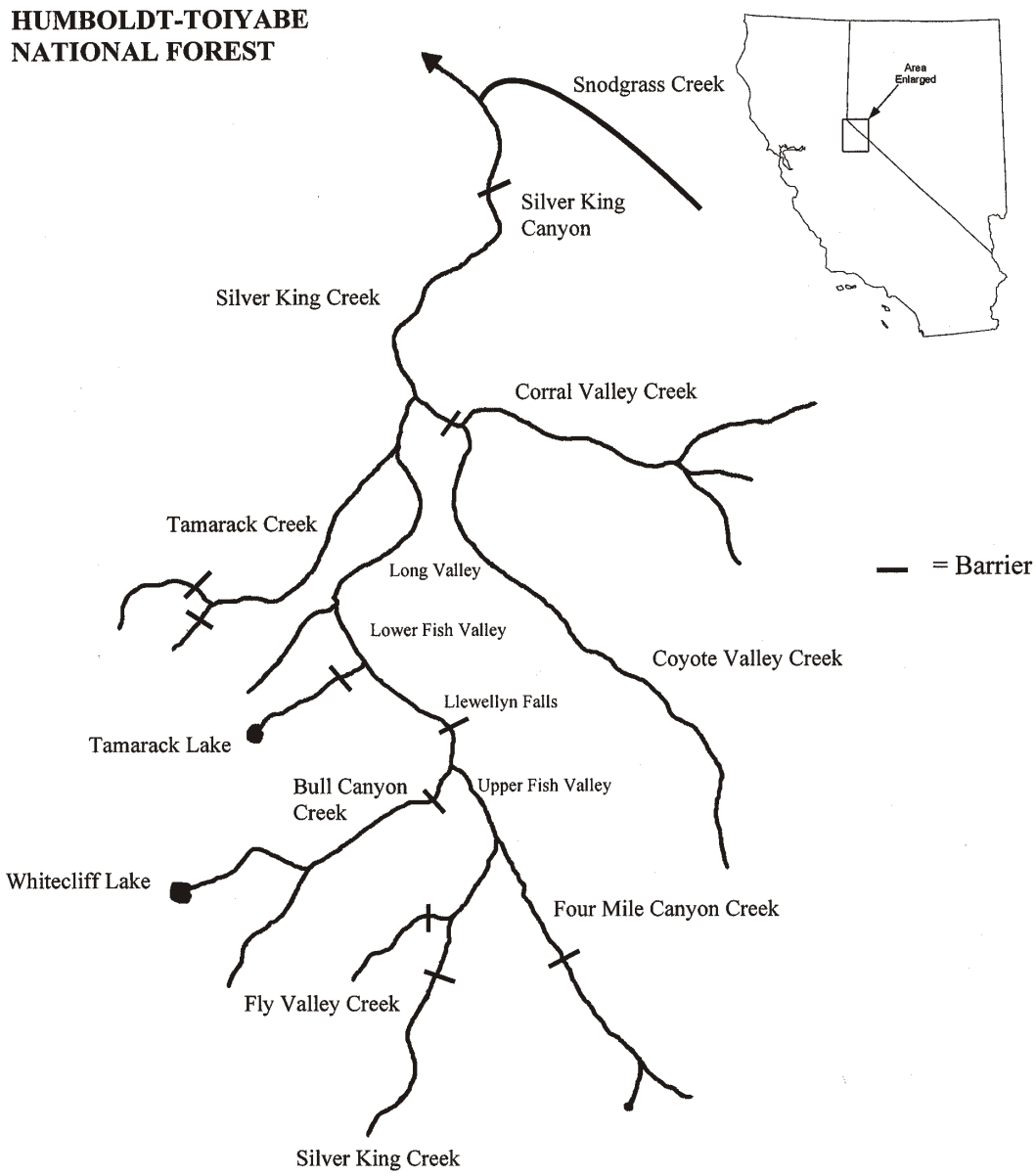


Figure 1. Silver King Creek and its tributaries (including barriers), Humboldt-Toiyabe National Forest, Alpine County, California

B. Species Description

The Paiute cutthroat trout is a distinctive member of the cutthroat trout complex, distinguishable from other cutthroat trouts by body coloration and the absence, or near absence, of body spots. Snyder (1933, 1934) described these fish as a new species, (*Salmo seleniris*), based on: 1) absence of body spots; 2) slender body form; 3) relatively small scales; and 4) vivid coloration. Subsequent comparisons of the type specimens with other cutthroat subspecies (Ryan and Nicola 1976, Behnke 1980) revealed that the meristic (relating to number and relation of body parts) and morphometric (relating to measurement of external form) characters for Paiute cutthroat trout are also typical of those characterizing Lahontan cutthroat trout. In recognition of the similarity of Paiute cutthroat trout and other cutthroat subspecies, Vestal (1947) relegated the Paiute cutthroat trout to a subspecies of *Salmo clarki*. Miller (1950) and Shapovalov and Dill (1950) accepted this reclassification and it was recognized as *Salmo clarki seleniris*. All western North American trout have been reclassified from the genus *Salmo* to the genus *Oncorhynchus*, as summarized by Smith and Stearly (1989) and adopted by the American Fisheries Society's Committee on Names of Fishes (Robins et al. 1991).

Behnke and Zarn (1976) concluded, on the basis of gillraker comparisons, that the separation of Paiute cutthroat from Lahontan cutthroat occurred relatively recently (no more than 5,000 to 8,000 years ago), following the desiccation of Lake Lahontan. Paiute cutthroat trout and Lahontan cutthroat trout both typically possess 150 to 180 lateral series scales, 60 to 63 total vertebrae, 50 to 70 pyloric caeca (finger-like projections of the small intestine), and 21 to 27 gill rakers (bony projections from the gill arches). In the past, it was not possible to distinguish between the two subspecies on the basis of electrophoretic analytical techniques (Busack and Gall 1981). However, development of diagnostic DNA microsatellite markers may provide discrimination in the future (B. May, University of California, Davis, California, pers. comm. 2001).

Body spotting is the primary diagnostic character distinguishing the Paiute cutthroat trout from the Lahontan cutthroat trout. Paiute cutthroat trout have been known to have up to 9 body spots, but rarely more than 5, whereas Lahontan

cutthroat trout typically possess 50 to 100 body spots and may have more. A secondary, but unquantifiable, distinguishing character is body coloration. Paiute cutthroat trout are typically coppery to purplish-pink, whereas Lahontan cutthroat trout from comparable stream environments are normally silver-yellow to light green.

C. Associated Candidate Species

In addition to Paiute cutthroat trout, two amphibian species that are candidates for listing, the mountain yellow-legged frog (*Rana muscosa*) and Yosemite toad (*Bufo canorus*), are known to occur in the Silver King Creek drainage.

1. Sierra Nevada Population of Mountain Yellow-legged Frog

On October 12, 2000, we published a 90-day finding for a petition to list the Sierra Nevada population of the mountain yellow-legged frog under the Endangered Species Act (U.S. Fish and Wildlife Service 2000a). We found the petition to have substantial evidence that listing the species as endangered may be warranted. We subsequently prepared a 12-month finding on the petition to list the Sierra Nevada population of the mountain yellow-legged frog. This finding was published in the Federal Register on January 16, 2003 (U.S. Fish and Wildlife Service 2003). We found that proposing to list this population was warranted but precluded by higher priority listing actions, and the population is now considered a candidate for listing. The southern California population of the mountain yellow-legged frog, which is currently listed as endangered, does not occur within the range of the Paiute cutthroat trout.

The mountain yellow-legged frog is a member of the family Ranidae (true frogs). It is a medium-sized frog with adults reaching 50 to 80 millimeters (2.0 to 3.1 inches) in length. The species attains lengths of 67 millimeters (2.6 inches) in males and 80 millimeters (3.1 inches) in females (Zweifel 1955, 1968). Their undersides range from a cream color to brilliant yellow. Dorsal coloration varies from drab olive to dark brown, with patterns ranging from discrete dark spots that can be few and large, to smaller and more numerous spots with a mixture of size

and shapes. Tadpoles reach up to 76 millimeters (3.0 inches) in size and take from 2 to 4 years to metamorphose. Male frogs can smell strongly of garlic during the breeding season. The call of the male frogs is rarely heard because they vocalize while underwater.

Within the Silver King Creek drainage, mountain yellow-legged frogs have been observed along the mainstem in Upper Fish Valley, the artificial channel in Upper Fish Valley, the lower portion of Fly Valley Creek, and at Whitecliff Lake. As recently as 1993, several thousand mountain yellow-legged frogs were observed in the Silver King Creek drainage along the shores of Whitecliff Lake (P. Shanley, U.S. Forest Service, pers. comm. 2000). Prior to 2001, mountain yellow-legged frog occurrence information was primarily gathered during fish survey or management activities. In the summer of 2001, the California Department of Fish and Game conducted a drainage-wide survey for amphibians. No adult mountain yellow-legged frogs were observed at Whitecliff Lake or other areas within the Silver King Creek drainage. However, two mountain yellow-legged frog tadpoles were observed in an artificial channel created as rearing habitat for Paiute cutthroat trout in Upper Fish Valley. In 2002, three adult mountain yellow-legged frogs were observed above Llewellyn Falls in the course of Paiute cutthroat trout surveys.

Chango and Wolf Creek Lakes, south of the Silver King Creek drainage in the West Walker River drainage, historically supported mountain yellow-legged frogs. Chango Lake is approximately 4.0 kilometers (2.5 miles) from upper Silver King Creek. Wolf Creek Lake is approximately 4.8 kilometers (3.0 miles) from upper Silver King Creek. In 1999, approximately 200 adult and 300 larval frogs were seen at Chango Lake (P. Shanley, pers. comm. 2000). An early survey in 2001 at Chango Lake yielded no mountain yellow-legged frogs. However, in a follow-up late-season survey, a total of 3 adults and 95 tadpoles were observed (D. Becker, California Department of Fish and Game, pers. comm. 2001). The population in Wolf Creek Lake is believed to be extirpated.

A conservation assessment and strategy program has been initiated for the mountain yellow-legged frog. A draft assessment has been prepared by the U.S. Forest Service, in cooperation with State and Federal agencies, universities, and

research scientists, but has not yet been finalized. This conservation assessment will synthesize the best available information, including life history, habitat association, and risk factors and identify occupied and unoccupied habitats essential for the conservation of the species (U.S. Forest Service 2001).

2. Yosemite Toad

On October 12, 2000, we published a 90-day finding for the petition to list the Yosemite toad (U.S. Fish and Wildlife Service 2000b). We found the petition to have substantial evidence that listing the species as endangered may be warranted. Our 12-month finding on the petition to list the Yosemite toad was published in the Federal Register on December 10, 2002 (U.S. Fish and Wildlife Service 2002). We found that proposing to list the Yosemite toad is warranted, but precluded by higher priority listing actions; the species is now considered a candidate for listing.

The Yosemite toad is a high elevation species that occurs in the central Sierra Nevada Range (Stebbins 1966). Within the Silver King Creek drainage, the range of the Yosemite toad and western toad (*Bufo boreas*) overlap, and some degree of hybridization is suspected to occur. The Yosemite toad is a close relative of three toad species, the western toad, black toad (*B. exsul*), and Amargosa toad *(B. nelsoni*) (Blair 1972, Stebbins 1966). Yosemite/western toad hybridization occurs in the northern portion of the Yosemite toad's range in the Blue Lake region of the Carson-Iceberg Wilderness, just southeast of Carson Pass in Alpine County (Karlstrom 1962, Stebbins 1966). The Yosemite toad is a small to medium-sized toad with no head crests and large, flat circular parotoid glands (warty poison glands on the head) that are slightly separated (Karlstrom 1962). Yosemite toads show a high degree of sexual dimorphism (differing appearance of males and females). Females are larger and darker colored, with irregular dark blotches bordered with white, and males are smaller and speckled with black spots on a dull yellow to olive-greenish background and without distinct dark patches on their back (Karlstrom 1962).

A California Department of Fish and Game summer amphibian survey in 2001 documented occurrence of Yosemite toads, western toads, and hybrid

Yosemite/western toads in the Silver King Creek drainage. Yosemite toads have also been observed in Silver Creek Meadows, which is situated below Chango Lake, in the West Walker River drainage. No quantitative surveys have been conducted to assess population size in the Silver King drainage. Additionally, the Sierra National Forest has been conducting surveys for Yosemite toads for the past decade. Yosemite toads have been noted in the Stairway Creek drainage in 1996, 2000, and 2001, and at Sharktooth Lake in 1999 (P. Strand, Sierra National Forest, pers. comm. 2002). A conservation assessment that is similar to efforts by the U.S. Forest Service for the mountain yellow-legged frog will also be undertaken for the Yosemite toad.

Other than recent surveys, no specific conservation actions directed towards the mountain yellow-legged frog and Yosemite toad in the Silver King Creek drainage have been completed. However, several measures including livestock grazing closures and other habitat improvement projects have likely benefitted the mountain yellow-legged frog and Yosemite toad. Habitat improvements to the artificial channel in Upper Fish Valley have been a benefit to both amphibians. The chemical treatment of Bull Canyon Creek above the falls to Whitecliff Lake and the cessation of stocking in Tamarack Lake have reduced the impacts associated with introduced trout.

Prior to treatment to remove introgressed fish below Llewellyn Falls, amphibian surveys will be conducted on lower Silver King Creek, Tamarack Lake, Tamarack Creek, and other tributaries entering into the mainstem in that reach. All amphibians captured in surveys will be relocated during the treatments. There may be some negative impacts on amphibians if they are not captured during the relocation process or through stress of handling. However, the long-term effects of removal of nonnative and hybrid fish will be beneficial to native amphibians.

Whitecliff Lake, Tamarack Lake, and their outflows will be maintained as fishless waters. Amphibian populations will be monitored annually and biological and ecological data will be gathered. An evaluation is expected to be completed annually following the treatment to determine whether recolonization

is occurring naturally or if the reintroduction from adjacent amphibian populations is necessary.

Recommendations from the range-wide conservation assessment and strategy efforts will be incorporated into management activities within the Silver King Creek drainage. These two amphibian species also co-occur with the four out-of-basin populations of Paiute cutthroat trout (North Fork Cottonwood, Stairway, Sharktooth, and Cabin Creeks), and conservation efforts will also be undertaken at these locations.

D. Life History and Habitat Requirements

Few studies have been completed on the biology of the Paiute cutthroat trout. Most of what is known is based on studies conducted by Wong (1975) and Diana (1975) on the introduced population in the North Fork of Cottonwood Creek, Mono County, California. Its life history and habitat requirements appear to be similar to those reported for other western stream-dwelling salmonids. All life stages require cool, well-oxygenated waters. Adult fish prefer stream pool habitat in low gradient meadows with undercut or overhanging banks and abundant riparian vegetation (Behnke and Zarn 1976). Pools are important rearing habitat for juveniles and act as refuge areas during winter (Raleigh *et al.* 1984; Swales *et al.* 1986; Berg 1994). During the winter months, trout move into pools to avoid physical damage from ice scouring (Hartman 1965; Scrimgeour *et al.* 1994) and to conserve energy (Everest and Chapman 1972; Cunjak 1996). As with other salmonids, suitable winter habitat may be more restrictive than summer habitat (Jakober *et al.* 1998). Paiute cutthroat trout survive in lakes, but there is no evidence that they ever occurred naturally in any lakes within the Silver King basin. Paiute cutthroat trout demonstrate fluvial spawning behavior and must have access to flowing waters with clean gravel substrates.

Paiute cutthroat trout reach sexual maturity at the age of 2 years. Peak spawning activity occurs in June and July (Wong 1975). The eggs hatch in 6 to 8 weeks and the fry emerge from the gravel in another 2 to 3 weeks. Young-of-the-year fish rear in mainstem shoals or backwaters, and often move into intermittent tributary streams until they reach about 50 millimeters (2.0 inches) in length

(Diana and Lane 1978; W. Somer, California Department of Fish and Game, pers. comm. 2001).

Paiute cutthroat trout are opportunistic feeders, utilizing whatever aquatic and terrestrial invertebrates occur in the drift. They set up dominance hierarchies and defend these positions (Wong 1975). The largest fish typically occupy pools, while the smaller fish utilize runs and riffles and whatever other unoccupied habitats are available. Growth rates vary with water temperature and the abundance of food organisms. In stream environments Paiute cutthroat trout seldom reach sizes in excess of 250 millimeters (10 inches) total length (Moyle 1976). They attain a maximum size of 342 millimeters (13.5 inches) in Silver King Creek (W. Somer, pers. comm. 2002). In lakes they may grow to 450 millimeters (18 inches) or more (Ryan and Nicola 1976).

Paiute cutthroat trout eggs and fry have several natural predators -- water shrews (*Sorex palustris*), dippers (*Cinclus mexicanus)*, and trichopteron larvae -- but adult fish have few predators. Disease is apparently a significant cause of adult mortality, particularly in the post-spawning period. Wong (1975) observed extensive fungal infections on the dorsal and caudal fins of several spawned-out fish in the North Fork of Cottonwood Creek. Many of these fish were so weakened by spawning they were unable to recover. This fungal infection has never been observed outside of North Fork of Cottonwood Creek. Few Paiute cutthroat trout apparently live beyond the age of 3 years in a wild stream environment (Wong 1975).

Paiute cutthroat trout are less wary than other trouts, presumably because they evolved in a high mountain environment where terrestrial and avian predators are not frequently encountered (Moyle 1976). Their unwariness makes them highly vulnerable to angling. Significant population declines have been noted in waters that are exposed to moderate or even light fishing pressure (MacPhee 1966; Behnke 1980).

E. Distribution

The presumed historic distribution of the Paiute cutthroat trout is limited to 14.7 kilometers (9.1 miles) of habitat, in Silver King Creek (from Llewellyn Falls downstream to Silver King Canyon) as well as the accessible reaches of three small named tributaries: Tamarack Creek, Tamarack Lake Creek, and the lower reaches of Coyote Valley Creek downstream of barrier falls (Figure 1). This watershed is entirely within the boundaries of the Humboldt-Toiyabe National Forest. The issue of what constitutes the native range is complicated by the paucity of early collection records and the conflicting recollections of early observers. The situation is further complicated by one or more unofficial transplants, and by natural events that may have altered the course of Silver King Creek. The account presented here is based on the conclusions of Ryan and Nicola (1976) and supported by Behnke (1980).

A barrier or series of barriers that developed in the Silver King Canyon during the last 10,000 years led to the isolation of Paiute cutthroat trout from Lahontan cutthroat trout. Connell and others reported that a high falls exists on lower Silver King Creek a short distance upstream from its confluence with Snodgrass Creek (Ashley 1970). A 1994 California Department of Fish and Game survey identified six potential fish barriers in the Silver King Canyon, the two highest being 2.44 meters (8 feet) and 3.05 meters (10 feet) in two separate channels.

Steep barrier falls exist at several locations on the mainstem and tributaries of Silver King Creek. The locations of all known fish barriers in the Silver King Creek drainage are shown in Figure 1. Llewellyn Falls is assumed to have been a historic barrier to upstream fish movements in Silver King Creek on the basis of Virgil Connell's observations and recollections. Connell, an early grazing permittee in the basin, reported that there were no fish above Llewellyn Falls in the early 1890's (V. Connell, letter in Ryan and Nicola 1976). In 1912, Joe Jaunsaras, a herdsman employed by Connell, caught some fish below Llewellyn Falls and transplanted them into Silver King Creek above the falls (V. Connell, letter in Ryan and Nicola 1976). According to Connell these (unspotted) fish increased in numbers above the falls ". . . until in 1924 the stream was so well

stocked, that fishing above the falls was better than below." Connell also noticed that sometime during this period the fish below the falls became " . . . mixed with other kinds, probably due to the stocking on the lower stream of different varieties."

An alternative scenario for the introduction of Paiute cutthroat trout into upper Silver King Creek is presented by Ashley (1970). He concluded, on the basis of conversations with a herdsman, that the 1912 transplant was a failure and that the population above Llewellyn Falls became established as the result of an introduction in 1924. John Jaunsaras, the brother of the herdsman who made the 1912 transplant, reported that he and another man carried 75 5-gallon buckets of trout upstream around the falls. The fish reportedly originated from a small tributary of Silver King Creek that entered the mainstem just below Llewellyn Falls. Ryan and Nicola (1976) rejected this explanation because large numbers of fish were reported to be present above Llewellyn Falls by Connell in 1924, and because the purported donor population below Llewellyn Falls may already have become introgressed by 1924. There is no evidence to suggest that the population above Llewellyn Falls became introgressed anytime before 1949.

The means by which rainbow trout and Lahontan cutthroat trout gained access to historic Paiute cutthroat trout habitat, and the date on which it first occurred, are not known. It may have happened in the mid-1920's as the result of a flood that changed the course of Silver King Creek. Ashley (1970) accepted Connell's account of a severe cloudburst in the Silver King Creek drainage in 1927, and concluded that the resultant flood altered the course of Silver King Creek near its confluence with Snodgrass Creek and eliminated a historic waterfall. Alternatively, rainbow trout and Lahontan cutthroat trout may have been introduced by early ranchers or anglers.

By 1933 when Snyder made his collections in Silver King Creek, the population below Llewellyn Falls consisted of heavily spotted fish, and the population above Llewellyn Falls was made up of fish without any, or with only a small number of, body spots. Of the 79 specimens of Paiute cutthroat trout collected by Snyder from above Llewellyn Falls in 1933, 47 had no body spots

and the remaining 32 had from 1 to 9 body spots (S. Nicola, pers. comm. in U.S. Fish and Wildlife Service 1985).

It is not known if Paiute cutthroat trout are native to Corral Valley Creek and its tributary Coyote Valley Creek (Figure 1). Falls near the mouth of Corral Valley Creek are assumed to have been a historic fish barrier. However, there are no records to confirm that this tributary was originally barren of fish. Ashley (1970) reported that both Corral Valley and Coyote Valley Creeks contained Paiute cutthroat trout when Connell first visited the area in 1889. Connell believed their presence was due to the activities of French-Canadian loggers who were working in the area in the 1860's (Ashley 1970). Vestal (1947) made the first documented collections from these two streams in 1946, and believed that the streams were ". . . formerly barren of fish life." He attributed their presence to the activities of sheepmen who ". . . reportedly planted Piute (sic) trout a few at a time in buckets from Upper Fish Valley."

Sometime after 1950, Paiute cutthroat trout in Silver King Creek above Llewellyn Falls became introgressed as the result of introductions of rainbow and Lahontan cutthroat trout into the upper watershed by the California Department of Fish and Game. Planting records indicate that 5,040 rainbow trout fry were stocked above Llewellyn Falls during September 1949. It is unclear when or where Lahontan cutthroat trout were stocked above Llewellyn Falls. The populations in Corral Valley and Coyote Valley Creeks also became introgressed sometime during the 1950's from an unknown source.

Efforts to restore pure populations of Paiute cutthroat trout above Llewellyn Falls appear to have been successful following multiple chemical treatments, combined with removal of hybridized trout using electrofishing. A 3-year chemical treatment project conducted during 1991 through 1993 successfully removed hybrid trout from Silver King Creek in Upper Fish Valley upstream from Llewellyn Falls. The population of Paiute cutthroat trout in Fly Valley Creek has remained isolated by a barrier falls. Hybridized trout have been removed from Four Mile Canyon Creek by electrofishing and chemical treatment during 1991 through 1993. Corral Valley Creek was chemically treated during 1964, and retreated during 1977 to remove hybridized trout. Electrofishing surveys

following the 1977 treatment eliminated surviving hybridized trout. The chemical treatments of Coyote Valley Creek during 1964 and 1977 failed, however, retreatment during 1987 and 1988 appears successful because no hybrid trout have been observed during subsequent electrofishing surveys. These results have been reconfirmed by allozyme and nuclear DNA analysis of tissue samples from all populations (Israel *et al.* 2002).

In summary, available evidence suggests that the native range of the Paiute cutthroat trout is limited to the reach of Silver King Creek between Llewellyn Falls and a presumed historic barrier in Silver King Canyon, and all accessible tributaries within this reach. This range constitutes about 14.7 kilometers (9.1 miles) of stream habitat. It is also possible that Paiute cutthroat trout are native to Corral Valley and Coyote Valley Creeks, but that will probably remain a matter of conjecture because there are no collection records available from these streams to document their faunal composition before they were influenced by man. For this reason, there is also a slight possibility that Connell's account of the situation is incorrect and that the true native range of the Paiute cutthroat trout is Silver King Creek above Llewellyn Falls.

Following Snyder's discovery and description, the California Department of Fish and Game made several attempts to transplant Paiute cutthroat trout into other waters. The first documented introduction was made in 1937 into upper and lower Leland Lakes. That transplant failed, but another effort was made in 1946 when they were introduced into the North Fork of Cottonwood Creek. Progeny of that transplant survive to the present. A list of known transplant attempts is shown in Table 1. The present distribution of Paiute cutthroat trout consists of a population in Silver King Creek above Llewellyn Falls and tributary populations in Fly Valley, Four Mile Canyon Creek, Coyote Valley, and Corral Valley Creeks (Figure 1), and four self-sustaining, pure populations outside the native drainage in the North Fork of Cottonwood and Cabin Creeks (Figure 2), and Stairway and Sharktooth Creeks (Figure 3). The introduced population in Delaney Creek, Yosemite National Park, Tuolumne County, introduced in 1968, is suspected to be extirpated due to the presence of brook trout (*Salvelinus fontinalis*). The only

Table 1. Recorded transplants of Paiute cutthroat trout.

Water	Year	Source	Number	Status
Lower and Upper Leland Lakes (El Dorado Co., CA)	1937	Silver King Cr.	400	Disappeared by 1941.
North Fork of Cottonwood Cr. (Mono Co., CA)	1946	Silver King Cr. Coyote Valley Cr. Corral Valley Cr.	125 249 27	Reproducing population established.
McGee Cr. (Mono Co., CA)	1956	North Fork of Cottonwood Cr.	?	Unsuccessful.
Bull Lake (Alpine Co., CA)	1957	Silver King Cr.	46	Unsuccessful.
Birchim Lake (Inyo Co., CA)	1957	North Fork of Cottonwood Cr.	70	Highly Introgressed.
Delaney Cr. (Tuolumne Co., CA)	1966	Four Mile Canyon Cr. Fly Valley Cr.	40 3	Displaced by brook trout.
Sharktooth Lake (Fresno Co., CA)	1968	North Fork of Cottonwood Cr. Delaney Cr.	23 6	Population established in outflow (Sharktooth Creek).
Cabin Cr. (Mono Co., CA)	1968	North Fork of Cottonwood Cr.	60	Small reproducing population established.
Stairway Creek (Madera Co., CA)	1972	Delaney Cr.	77	Reproducing population established.
Heenan Lake (Alpine Co.. CA)	1983	Coyote Valley Cr.	170	Unsuccessful.

known self-sustaining lake population in Birchim Lake (Inyo National Forest, Inyo County) was confirmed to be introgresssed with rainbow trout in 1984 (D. Wong, California Department of Fish and Game, pers. comm. 2000).

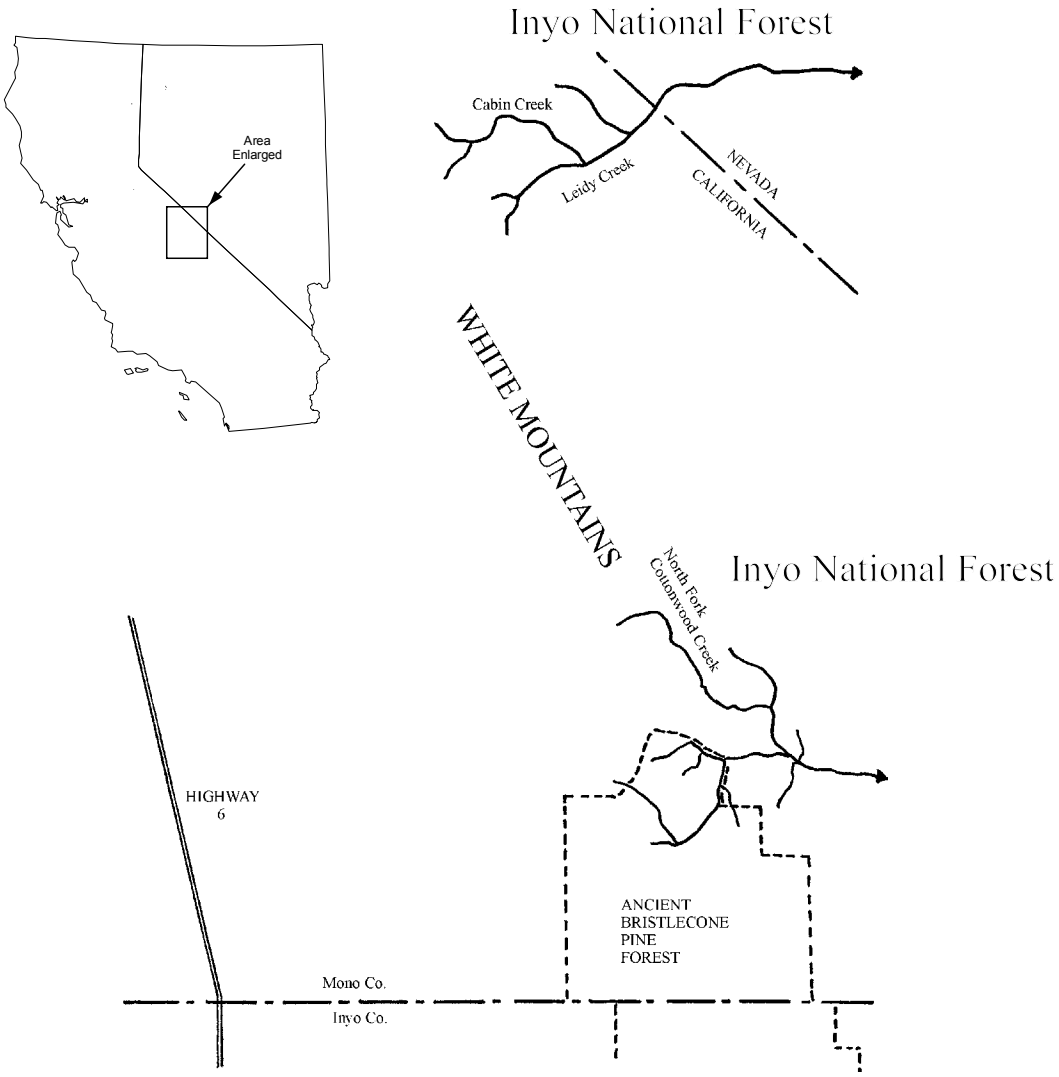


Figure 2. Refugial populations of Paiute cutthroat trout in North Fork Cottonwood Creek and Cabin Creek, Inyo National Forest, Mono County, California.

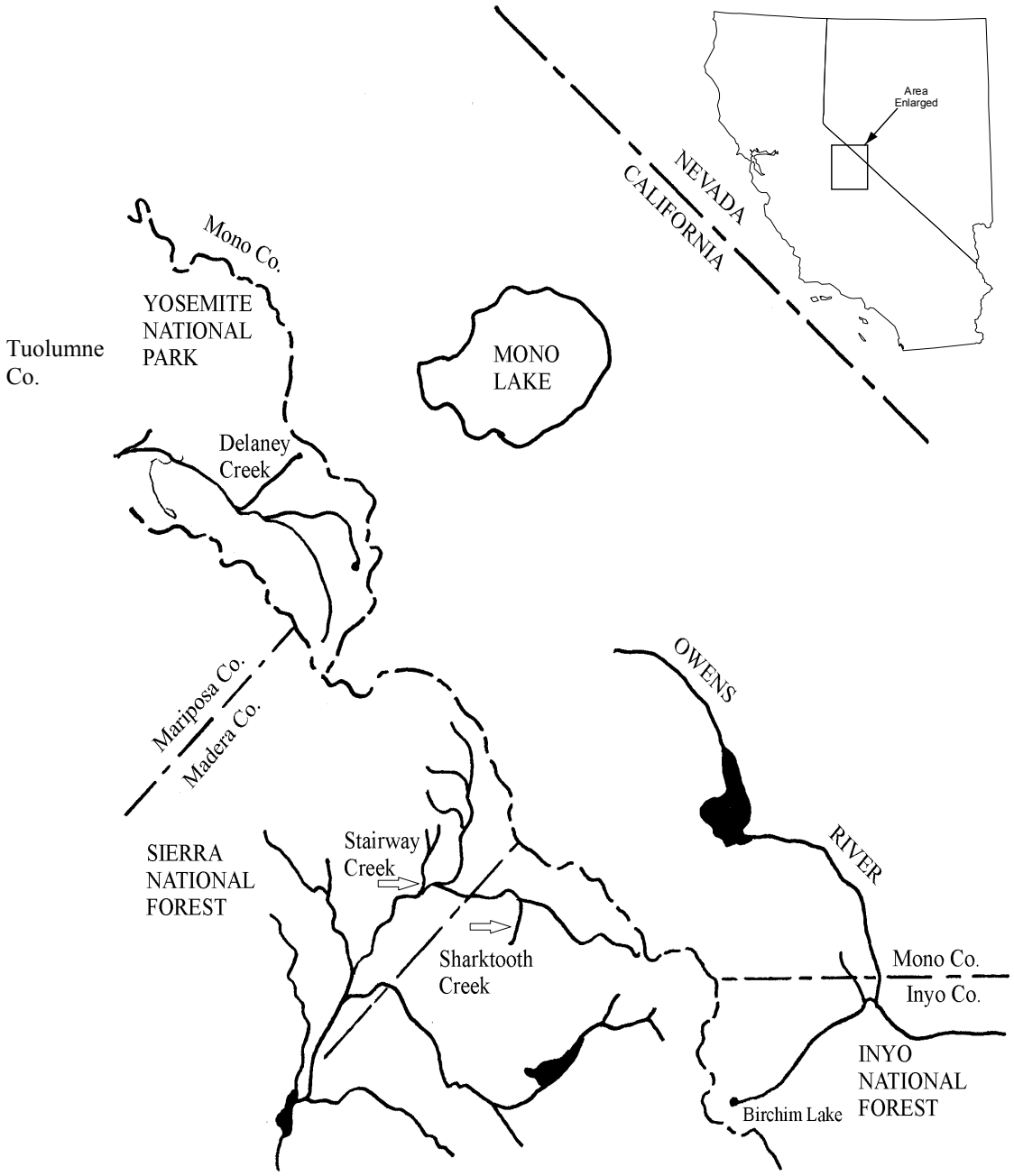


Figure 3. Refugial populations of Paiute cutthroat trout in Sierra National Forest, in Stairway Creek, Madera County, and Sharktooth Creek, Fresno County, California.

F. Abundance

1. Silver King Creek Drainage

Paiute cutthroat trout now occupy a minimum of 33.2 kilometers (20.6 miles) of stream habitat in five widely separated drainages. Populations in the Silver King Creek drainage occupy about 18.6 kilometers (11.5 miles) of stream habitat, including 12.9 kilometers (8 miles) of good quality habitat that supports on average 1,020 adult fish (> 150 millimeters [6 inches]) in 6 stream populations (Figures 4-8). Paiute cutthroat trout occupy approximately 4.3 kilometers (2.7 miles) in Silver King Creek above Llewellyn Falls. Results from the 2001 population survey in Upper Fish Valley were within the range of its historical population abundance, suggesting that the population may still be expanding (Figure 4). A total of 217 adult trout were observed during the snorkel and electrofishing surveys in 2001. Based on population estimates that compare multiple-pass electrofished test sections, the population could consist of as many as 424 adult fish, which is the average number of adults for this 1,900-meter (1.2-mile) reach. Figures 4 through 8 show how variable these populations can be as well as how quickly Paiute cutthroat trout rebound from chemical treatments and natural disturbance.

Twenty population estimate surveys have been conducted on Four Mile Canyon Creek. The first was in 1968, and they have been conducted nearly every year since 1984. Figure 5 shows the results from those surveys. In 2000, California Department of Fish and Game surveyed 250 meters (820 feet) of stream and estimated 78 adult fish per kilometer (126 per mile), which is lower than the average of 133 adult fish per kilometer (215 per mile). Adult numbers have stayed relatively constant while juvenile numbers have fluctuated widely. Paiute cutthroat trout occupy approximately 3 kilometers (1.9 miles) of habitat in Four Mile Canyon Creek.

Seven population estimate surveys have been conducted on Fly Valley Creek. The first survey was in 1984 and the last was in 2000 (Figure 6). In 2000, California Department of Fish and Game surveyed 150 meters (492 feet) of stream and estimated 118 adult fish per kilometer (190 per mile), which is lower

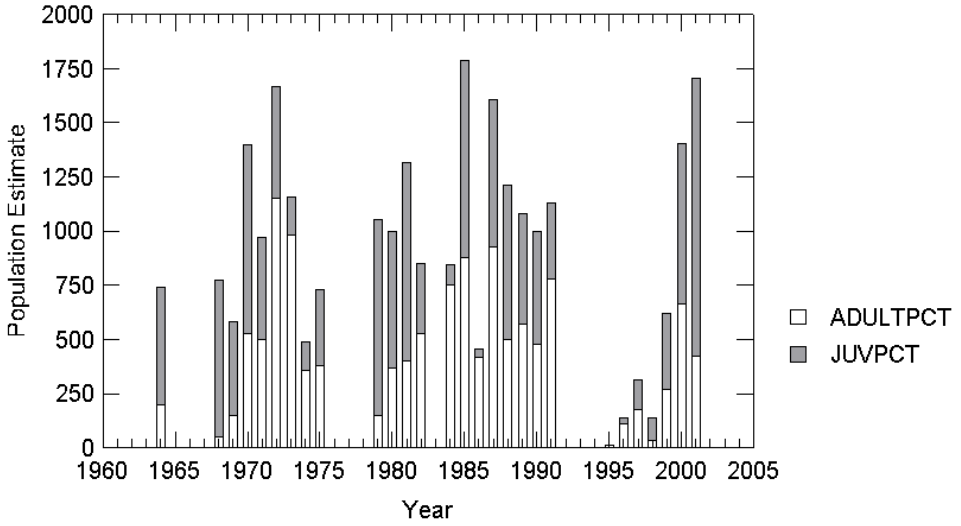


Figure 4. Historical population estimates (1964 to 2001) from the Upper Fish Valley reach of Silver King Creek. The white bars represent adult Paiute cutthroat trout (over 150 millimeters [6 inches]) and the dark bars represent juvenile Paiute cutthroat trout (under 150 millimeters [6 inches]). Upper Fish Valley was treated with rotenone in 1964, 1976, and 1991 to 1993. The Silver King Creek drainage experienced heavy runoff in 1982, 1986, and 1998. (W. Somer, California Department of Fish and Game, unpubl. data).

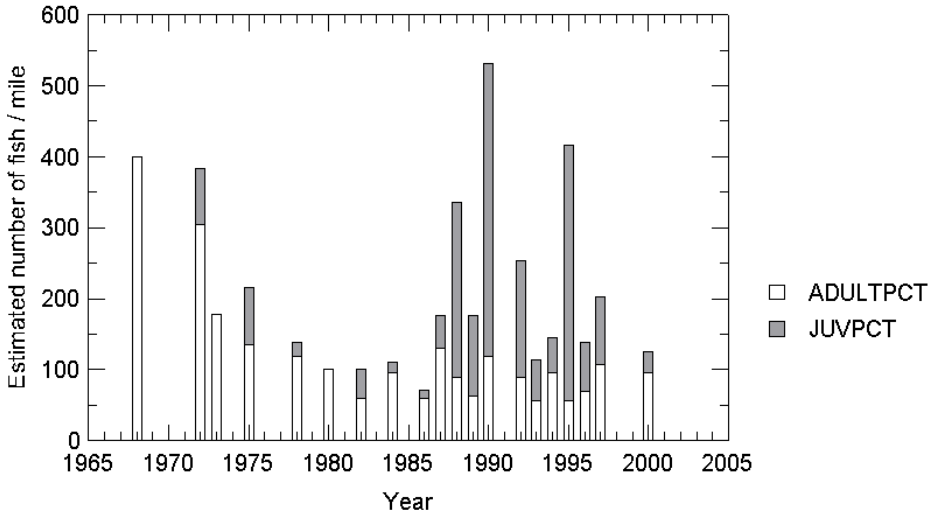


Figure 5. Historical population estimates (1968 to 2000) from Four Mile Canyon Creek in the Silver King Creek drainage. The white bars represent adult Paiute cutthroat trout (over 150 millimeters [6 inches]) and the dark bars represent juvenile Paiute cutthroat trout (under 150 millimeters [6 inches]). In 1968, 1973, and 1980 population estimates represent both adult and juvenile fish. Four Mile Canyon Creek was treated with rotenone from 1991 to1993. The Silver King Creek drainage experienced heavy runoff in 1982, 1986, and 1998. (W. Somer, California Department of Fish and Game, unpubl. data).

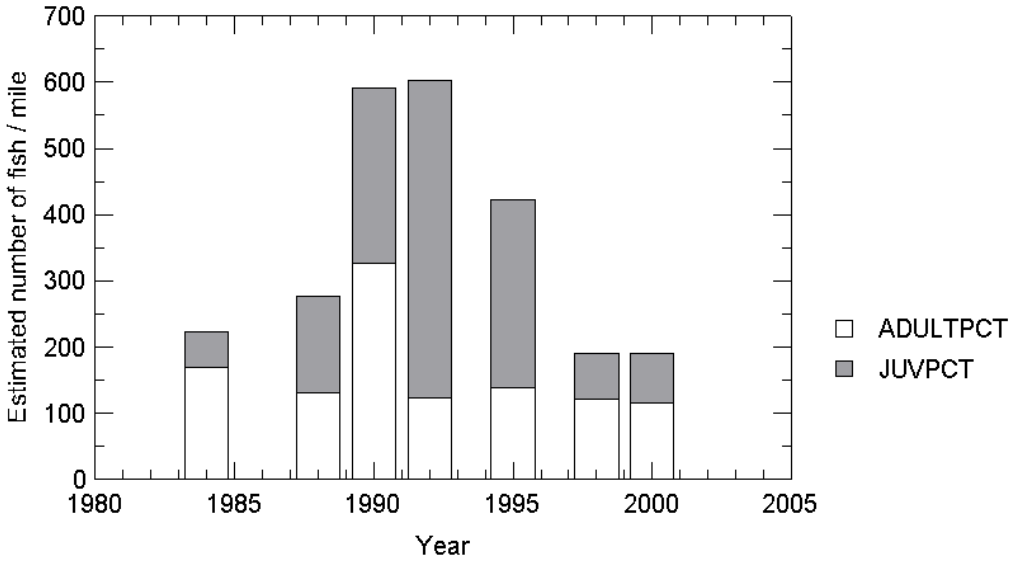


Figure 6. Historical population estimates (1984 to 2000) from Fly Valley Creek in the Silver King Creek drainage. The white bars represent adult Paiute cutthroat trout (over 150 millimeters [6 inches]) and the dark bars represent juvenile Paiute cutthroat trout (under 150 millimeters)[6 inches]. Fly Valley Creek has never been treated with rotenone. The Silver King Creek drainage experienced heavy runoff in 1982, 1986, and 1998. (W. Somer, California Department of Fish and Game, unpubl. data).

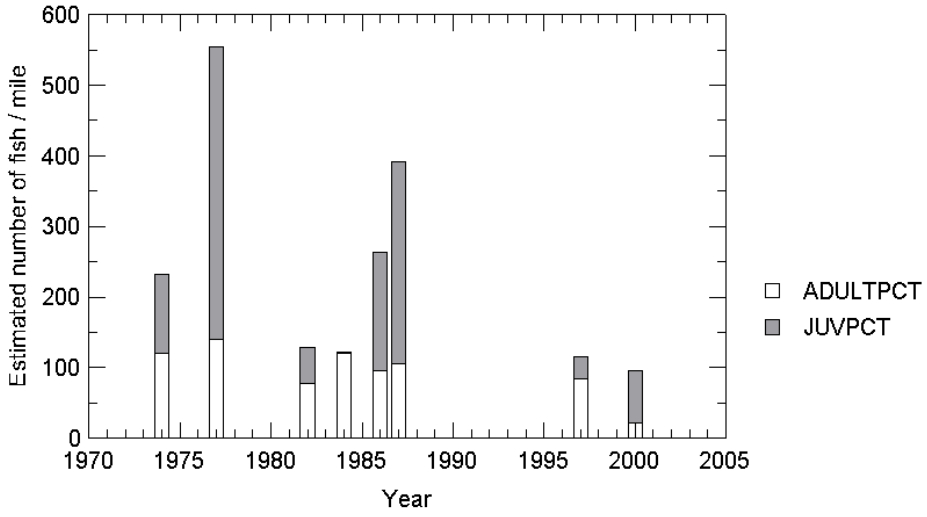
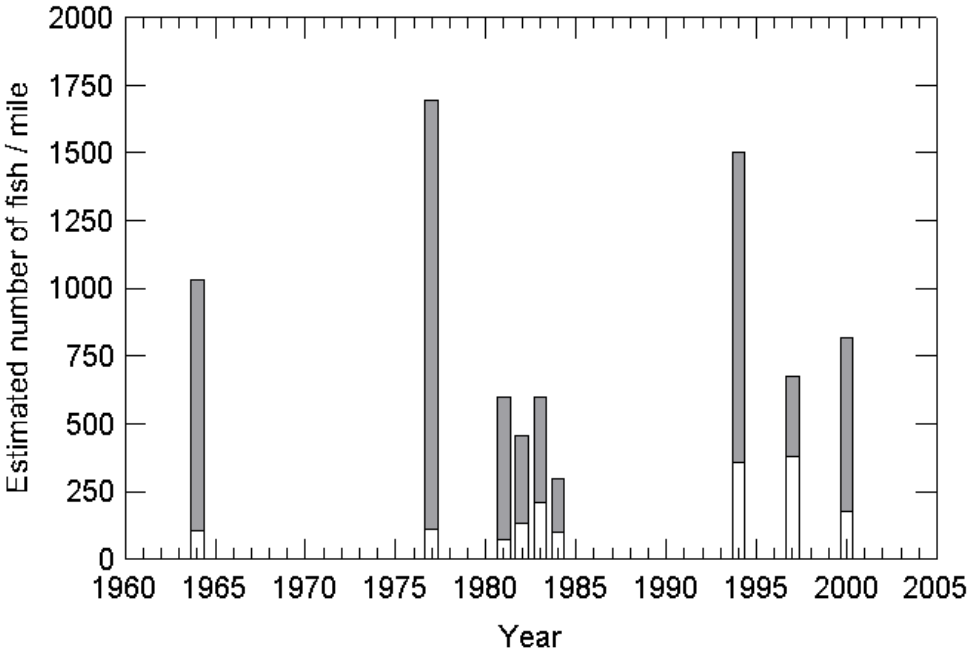


Figure 7. Historical population estimates (1974 to 2000) from Corral Valley Creek in the Silver King Creek drainage. The white bars represent adult Paiute cutthroat trout (over 150 millimeters [6 inches]) and the dark bars represent juvenile Paiute cutthroat trout (under 150 millimeters [6 inches]). Corral Valley Creek was treated with rotenone in 1964 and 1977. The Silver King Creek drainage experienced heavy runoff in 1982, 1986, and 1998. (W. Somer, California Department of Fish and Game, unpubl. data).

A



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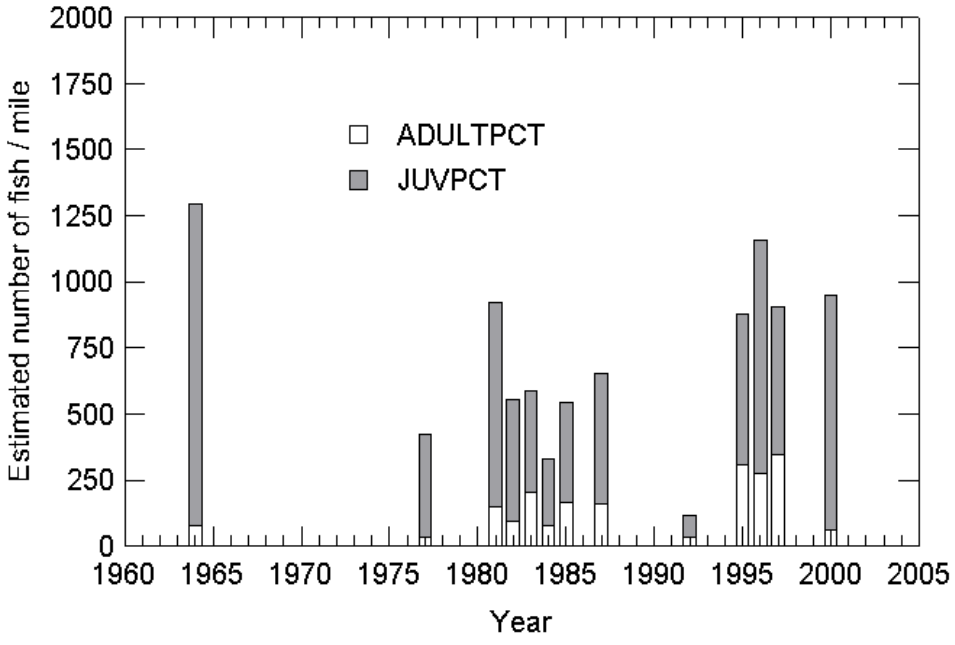

Figure 8. Historical population estimates (1984 to 2000) from Coyote Valley Creek in the Silver King Creek drainage. Figure A represents the Upper Meadow section and figure B represents the Lower Meadow section. The white bars represent adult Paiute cutthroat trout (over 150 millimeters [6 inches]) and the dark bars represent juvenile Paiute cutthroat trout (under 150 millimeters [6 inches]). Coyote Valley Creek was treated with rotenone in 1964, 1977, and 1987-1988. The Silver King Creek drainage experienced heavy runoff in 1982, 1986, and 1998. (W. Somer, California Department of Fish and Game, unpubl. data).

than the average of 221 adult fish per kilometer (356 per mile). While juvenile numbers have historically fluctuated, adult numbers have stayed relatively constant. Paiute cutthroat trout occupy approximately 1.8 kilometers (1.1 miles) of habitat in Fly Valley Creek.

Eight population estimate surveys have been conducted on Corral Valley Creek. The first survey was in 1974 and the last was in 2000 (Figure 7). In 2000, California Department of Fish and Game surveyed a 150-meter (492-foot) section and estimated 59 adult fish per kilometer (95 per mile), which is lower than the average of 148 adult fish per kilometer (238 per mile). It is unclear why the population decreased in 2000, but this decrease is most likely due to natural fluctuations in the population. Paiute cutthroat trout occupy approximately 3.6 kilometers (2.2 miles) of habitat in Corral Valley Creek.

Population estimates on Coyote Valley Creek were sporadically conducted from 1964 to 2000 (Figure 8). Two separate 150-meter (492-foot) sections, Upper Meadow and Lower Meadow, were surveyed. In 2000, California Department of Fish and Game estimated 508 adult fish per kilometer (819 per mile) for the Upper Meadow section, which is slightly lower than the average of 528 adult fish per kilometer (852 per mile). The Lower Meadow section had an estimated 589 adult fish per kilometer (950 per mile), which is higher than the average of 444 adult fish per kilometer (716 per mile). Paiute cutthroat trout occupy approximately 4.9 kilometers (3 miles) of habitat in Coyote Valley Creek.

2. North Fork of Cottonwood Creek

Occupied habitat for Paiute cutthroat trout in the North Fork of Cottonwood Creek is limited to the uppermost 5.5 kilometers (3.4 miles) of stream above the Tres Plumas barrier. In 1946, 401 Paiute cutthroat trout from the Silver King Creek drainage (Table 1) were stocked. A standard section of stream, from Granite Meadow downstream to a standard point just above the Tres Plumas barrier, has been surveyed visually since 1989 by the California Department of Fish and Game (Figure 9). The exclusion of grazing since 1993

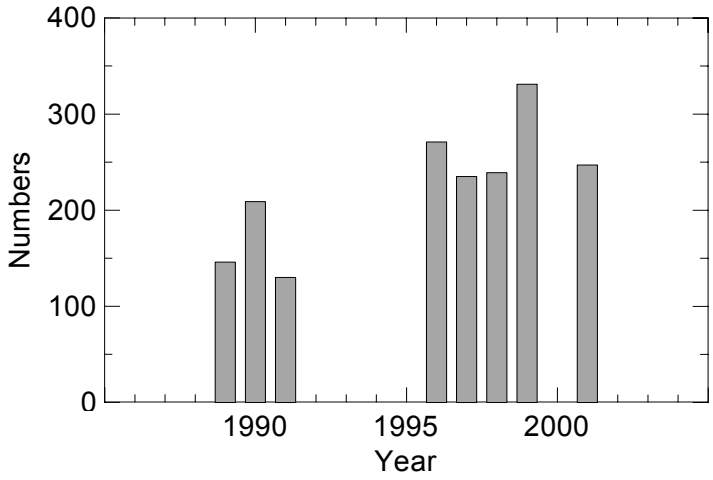

Figure 9. Visual observations from the North Fork of Cottonwood Creek, Inyo National Forest, since 1989. The numbers include all size classes observed (D. Becker, California Department of Fish and Game, unpubl. data).

and spawning enhancement projects in 1995 and 1996, which created 51 spawning sites, appear to have increased Paiute cutthroat trout numbers (D. Becker, unpubl. data).

3. Cabin Creek

Cabin Creek was originally stocked in 1968 with 60 individuals from the North Fork of Cottonwood Creek. Occupied habitat for Paiute cutthroat trout in Cabin Creek is approximately 2.4 kilometers (1.5 miles). Visual surveys were conducted on Cabin Creek in 1995 and 2000 (D. Becker, California Department of Fish and Game, unpubl. data). In 1995, 139 fish were observed and were broken down into size classes. Thirty-eight fish were between 100 and 200 millimeters (4 and 8 inches). The remaining 101 fish were between 200 to 254 millimeters (8 to 10 inches). In 2000, 186 fish were observed. This survey did not break down individual sizes, although multiple size classes were present.

4. Stairway Creek

The population in Stairway Creek occupies approximately 3.5 kilometers (2 miles) of stream habitat. Strand and Eddinger (1999) provide a summary of historic population estimates in Stairway Creek. In 1972, 77 individuals from Delaney Creek were stocked into Stairway Creek. Population surveys in Stairway Creek using electrofishing methods occurred in 1974 through 1977 and 1981. In 1974, surveys located 5 adults and in 1975, 12 individuals were located (6 adults and 6 juveniles). Surveys conducted in 1976 and 1977 showed a large increase in numbers found with 150 and 118 individuals respectively. In 1981, a more thorough survey was conducted, which estimated the population at 36.6 individuals per 100 meters (590 per mile) (excluding young of year) with 76 percent of the population estimated as adults (greater than 127 millimeters [5 inches]). In 1996, the Sierra National Forest conducted visual observations of Paiute cutthroat trout in each habitat by life stage on 2.5 kilometers (1.5 miles) of stream. Strand and Eddinger (1999) reported seeing 22.7 individuals per 100 meters (366 per mile) with an estimated 70 percent of the population being adults (greater than 127 millimeters [5 inches]). Comparison of population estimates between years is not statistically reliable since different methods were used and different lengths of stream were surveyed. A rain on snow event that occurred in 1997 resulted in down-cutting of the stream channel, reduced habitat complexity, and fewer fish during the 2000 survey (P. Strand, pers. comm 2002). However, the fish that were observed appeared more robust. Because of past mortality rates from electrofishing salmonids on the Sierra National Forest, fly rod depletion (Stephens and Christenson 1980) was selected as a means to estimate the number of fish per pool during the 2000 survey. Thirty pools were sampled with an average of 4.3 individuals per pool (P. Strand, unpubl. data). The fly rod depletion method is not intended to be statistically reliable and is biased towards larger fish; however, it can be used to determine the minimum number of fish per pool.

5. Sharktooth Creek

Strand and Eddinger (1999) also provide a summary of historic population estimates in Sharktooth Creek. In 1968, 29 individuals, 6 from Delaney Creek

and 23 from North Fork of Cottonwood Creek, were stocked into Sharktooth Lake. In 1970, a 4-hour angling survey conducted in the lake resulted in no fish taken. In 1973, visual surveys of the lake and outlet stream (Sharktooth Creek) resulted in no observations. In 1975, personnel of the California Department of Fish and Game noted several Paiute cutthroat trout in the outlet stream. The next survey was conducted in 1999 by Sierra National Forest personnel. Fish from Sharktooth Lake evidently moved downstream into Sharktooth Creek and now occupy approximately 3.2 kilometers (2 miles) of stream from the outlet of Sharktooth Lake to the confluence with Lost Keys Lake outlet stream. Fly rod depletion and visual observation were selected as a means to estimate the number of fish per pool (Stephens and Christenson 1980). Twenty-five pools were sampled in the only low gradient section of occupied habitat. Fifty-eight individuals were caught or observed in the pools for an average of 2.32 fish per pool. The fly rod depletion method is not intended to be statistically reliable and is biased towards larger fish; however, it can be used to determine the minimum number of fish per pool.

G. Habitat Description

1. Silver King Creek Drainage

As part of the California Wilderness Act, 65,000 hectares (160,000 acres) were set aside in 1984 as the Carson-Iceberg Wilderness. This area is managed both by the Humboldt-Toiyabe and Stanislaus National Forests. The entire portion of the Silver King Creek drainage occurs within the Humboldt-Toiyabe National Forest. This description of habitat is based on the account presented by Ryan and Nicola (1976).

Silver King Creek is a tributary of the East Fork Carson River, which drains into the Lahontan Basin. The creek originates at 2,926 meters (9,600 feet) elevation in the southernmost portion of the drainage, and flows north through three distinct valleys for approximately 22.5 kilometers (14 miles) where it meets the East Fork Carson River. Between the headwaters and the confluence of Silver King Creek with the East Fork Carson River, eight tributaries, three above and five below

Llewellyn Falls, join Silver King Creek. Llewellyn Falls, at an elevation of 2,438 meters (8,000 feet), is located at the head of Lower Fish Valley, some 16.2 kilometers (10 miles) above the confluence with the East Fork Carson River. The physical characteristics of Silver King Creek and its tributaries are described in Table 2.

From its source, Silver King Creek flows precipitously for 3.2 kilometers (2.0 miles) before beginning a gradual descent to Upper Fish Valley in an area of washed-out beaver ponds just above the mouth of Fly Valley Creek. For 2.4 kilometers (1.5 miles), through Upper Fish Valley, it is a typical meandering meadow creek, averaging 3.7 meters (12 feet) wide and 0.3 meter (1 foot) deep in the summer. Several soda springs occur in the valley, with some seeping directly into the stream. From the southeast, Four Mile Canyon Creek enters 2.0 kilometers (1.2 miles) above Llewellyn Falls, while Bull Canyon Creek joins the mainstem from the west 0.8 kilometer (0.5 mile) above Llewellyn Falls. In 1984, an abandoned stream channel was reconnected with the mainstem, providing 0.46 kilometers (0.3 miles) of spawning and juvenile rearing habitat. The upstream portion of the channel begins approximately 0.2 kilometer (0.1 mile) below the confluence of Silver King Creek and Four Mile Canyon Creek. The lower portion of the channel rejoins the mainstem immediately above the confluence of Silver King Creek and Bull Canyon Creek.

At the lower end of Upper Fish Valley, the stream gradient increases through a sparsely forested section before reaching Llewellyn Falls. The vertical drop of Llewellyn Falls is approximately 6.1 meters (20 feet). Within the 2.8-kilometer (1.7-mile) length of Lower Fish Valley, two small tributaries enter the mainstem from the west: Tamarack Lake Creek, located 1.2 kilometers (0.7 mile) below Llewellyn Falls, and a short, unnamed tributary downstream another 1.2 kilometers (0.7 mile). Long Valley, only 1.5 kilometers (0.9 mile) long, is the shortest of the three valleys. No tributaries enter this section of Silver King Creek. Between Lower Fish Valley and Long Valley the gradient increases, but no barriers similar to Llewellyn Falls are known to exist in this section. Below Long Valley, Tamarack Creek enters Silver King Creek from the west 0.6 kilometer (0.4 mile) below Long Valley, and Coyote Valley Creek enters from the east 1 kilometer (0.6 mile) farther downstream.

Table 2. Physical characteristics of Silver King Creek and its principal tributaries. Modified from Ryan and Nicola (1976). [1]

Stream	Length (kilometers)	Occupied habitat (kilometers	Historic habitat (kilometers)	Drainage area (hectares)	Elevation (meters) max	min	Average gradient (percent)
Fly Valley	2	1.8	0	414.4	2,682	2,512	8.5
Four Mile Canyon	4.5	3.0	0	880.6	3,048	2,487	12.5
Bull Canyon	4	1.0	0	673.4	2,902	2,463	11.0
Tamarack Lake	2	0	0.3	181.3	2,835	2,423	20.6
Unnamed tributaries	2.3	0	0.9	51.8	2,877	2,414	23.3
Tamarack	4.8	0	3.4	932.4	2,804	2,365	9.1
Coyote Valley	8	4.9	0.5	1,217.3	3,048	2,377	8.4
Corral Valley	5.6	3.6	0	1,346.8	3,347	2,743	7.1
Snodgrass	3.6	0	0	854.7	2,438	2,088	9.7
Silver King (exclusive of tributaries)	22.5	4.3	9.6	5,335.4	2,865	1,951	4.1
Total	59.3	18.6	14.7	11,914			

[1] Distances, areas, and elevations measured from USGS topographic maps.

Approximately 2.8 kilometers (1.7 miles) below the mouth of Coyote Valley Creek, Silver King Creek descends through Silver King Canyon and emerges from the canyon in the vicinity of Snodgrass Creek. Upstream from Snodgrass Creek, in the canyon, a series of falls present a fish barrier to nonnative trout and nonsalmonid native fish species that occur downstream. No tributary of significance enters Silver King Creek from Snodgrass Creek downstream for 5.4 kilometers (3.4 miles) until its confluence with the East Fork Carson River. Three small lakes occur in the drainage: 1) Tamarack Lake; 2) Whitecliff Lake; and 3) an unnamed lake in the headwaters of Four Mile Canyon Creek. The average gradient of Silver King Creek is 4.1 percent, which is less than any of its tributaries. However, the portion of Silver King Creek between Fly Valley and Corral Valley Creeks, has an average gradient of 1.6 percent.

In 1984, 1987, and 1990, personnel from the California Department of Fish and Game, U. S. Fish and Wildlife Service, and the U.S. Forest Service along with volunteers from Trout Unlimited participated in interdisciplinary functional assistance trips to the Silver King Creek drainage to conduct physical habitat and biological field surveys (see Appendix A). The objectives of this effort were to provide the National Forest with a general assessment of habitat and to provide recommendations for future management. Habitat surveys were performed using the General Aquatic Wildlife System procedures (Duff *et al*. 1989). A Habitat Condition Index is obtained using the General Aquatic Wildlife System methodology which can then be used to provide habitat trend data. Nine stations were monitored on Silver King Creek above Llewellyn Falls, two stations on Bull Canyon Creek, one station on Fly Valley Creek, two stations on Four Mile Canyon Creek, four stations on Coyote Valley Creek, and two stations on Corral Valley Creek (Appendix A, Table A1 and Figures A1 and A2). The Habitat Condition Index over this six year period improved in nearly all of the stations monitored, which was primarily due to a change in grazing management (Table 3). However, even though most stations increased their HCI rating, 13 of the 21 stations still rated as fair to poor. No habitat monitoring has been done since 1990, nor has any habitat monitoring been done throughout the historic range of Paiute cutthroat trout from Llewellyn Falls downstream to Silver King Canyon.

Table 3. Summary of Habitat Condition Index (HCI) ratings from 1984, 1987, and 1990. (Modified from Duff 1991).

Stream	Station	Channel Type	HCI 1984	HCI Rating 1984	HCI 1987	HCI Rating 1987	HCI 1990	HCI Rating 1990
Silver King	S1:610	C3	51.5	Poor	54.9	Poor	58.6	Poor
Silver King	S2:640	C3	65	Fair	55.3	Poor	84.2	Good
Silver King	S3:641	C3	64.8	Fair	54.6	Poor	78.8	Good
Silver King	S4:700	C3	38.5	Poor	37.9	Poor	68.4	Fair
Silver King	S5:725	C3	28.8	Poor	35.4	Poor	65.9	Fair
Silver King	S6:738	C3	48.3	Poor	54.6	Poor	69.7	Fair
Silver King	S6A:745	C3	58.5	Poor	66.7	Fair	70.4	Fair
Silver King	S7:775	B2/B3	63	Fair	63	Fair	69.7	Fair
Silver King	S8:813	C3	41.7	Poor	46.9	Poor	51	Poor
Bull Canyon	S1:040	C3	82.4	Good	83.7	Good	88.2	Excel.
Bull Canyon	S2:100	B2	54.3	Poor	57.8	Poor	69.4	Fair
Fly Valley	S1:500	B2/C2	84.4	Good	82.6	Good	83.4	Good
Four Mile	S1:250	C3	53	Poor	63.3	Fair	76.3	Good
Four Mile	S2:267	C3	---	---	77.7	Good	77.7	Good
Coyote	S1:400	C6	53	Poor	72	Good	75.2	Good
Coyote	S2:467	C3	58	Poor	61	Fair	77.4	Good
Coyote	S3:500	C6	40	Poor	68	Fair	69.1	Fair
Coyote	S4:542	C3	54.5	Poor	56.4	Poor	67.1	Fair
Corral	S1:571	C3	56	Poor	65.1	Fair	49	Poor
Corral	S2:574	C3	46.5	Poor	60.2	Fair	57.5	Poor

HCI Scale by Stream Type

HCI Rating	C3	C6	B2
Excellent	> 85	> 80	> 85
Good	75-84.9	70-79.9	75-84.9
Fair	60-74.9	60-69.9	60-74.9
Poor	< 60	< 60	< 60

Sediment samples were taken using a hollow core sampler during the functional assistance trips in 1984 and 1990. Five samples were taken in riffle areas at each station to determine how much fine sediment (particle sizes less than 6.35 millimeters [0.2 inches]) was present. Excess fine sediment is known to increase mortality of salmonid embryos (Chapman 1988; Bjornn and Reiser 1991) and could be a limiting factor in recruitment. Duff (1991) recommended that the minimum amount of fine sediment should not exceed 30 percent and that natural fine sediment amounts in Silver King Creek fluctuated between 20 and 30 percent. Results from this sampling effort revealed that the amount of fine sediment stayed constant between 1984 and 1990 (39.3 and 39.4 percent respectively) (Table A2). No sediment sampling has been done since grazing was stopped in 1994. The basin was logged in the 1860's, used as pasture for sheep in the early 1900's through the late 1930's, and used as pasture for cattle from the 1940's through 1994 (Overton *et al*. 1993; P. Shanley, pers. comm. 2000).

Macroinvertebrate sampling also occurred during the functional assistance trips in 1984, 1987, and 1990. Samples were collected at most of the General Aquatic Wildlife System stations using a Winget-modified surber net. Three types of indices were reported: (1) a diversity index (DAT), which combines a measure of dominance and number of taxa (Table A3); (2) standing crop, which is the community dry weight biomass per sample (Table A4); and (3) a biotic condition index (BCI), which indicates, as a percentage, how close an aquatic ecosystem is to its own potential (Table A5). No trends were observed during these functional assistance trips, however, both the diversity and biotic condition indices were rated good to excellent while the standing crop data ranged from poor to excellent.

In the late 1940's and early 1950's, beaver (*Castor canadensis*) were introduced into Silver King Creek and the upper East Fork of the Carson River drainages. By 1964, they had established active colonies in lower and upper Four Mile Canyon Creek, and in Fly Valley at the confluence of Fly Valley and Silver King Creeks. Beaver have since been trapped out or have abandoned their colonies, so as of 2002, there are no active beaver colonies in the drainage.

Table 4. Common and scientific names of the riparian plant communities in the Silver King Creek drainage (Modified from Winward 1984).

Common Name	**Scientific Name**
Geyer willow	*Salix geyeriana*
Lemmons willow	*Salix lemmonii*
Blueberry willow	*Salix boothii*
Eastwoods willow	*Salix eastwoodiae*
Sierra willow	*Salix orestera*
Little willow	*Salix planifolia*
Rocky Mountain sedge	*Carex scopulorum*
Nebraska sedge	*Carex nebrascensis*
Water sedge	*Carex aquatilis*
Rusty sedge	*Carex subfusca*
Winged sedge	*Carex microptera*
Beaked sedge	*Carex rostrata*
Kentucky bluegrass	*Poa pratensis*
Tufted hairgrass	*Deschampsia caespitosa*
Red fescue	*Festuca rubra*
Western needlegrass	*Achnatherum occidentalis*

In the nonmeadow portions of the watershed, Jeffrey pine (*Pinus jeffreyi*), lodgepole pine (*Pinus contorta*), and red fir (*Abies magnifica*) are the dominant conifers, while dense stands of aspen (*Populus tremuloides*) are common throughout the drainage. Sagebrush (*Artemisia tridentata*) is common near the outer periphery of the mainstem meadows. Six species of willow and sedges are the dominant riparian species present in the Silver King Creek drainage (Table 4).

2. North Fork of Cottonwood Creek

The North Fork of Cottonwood Creek is a small, spring-fed brook that originates on the east slope of Paiute Mountain, in the White Mountains of

east-central California. All occupied portions of the stream occur within the Inyo National Forest in Mono County (Figure 2). The stream flows southeasterly for approximately 7.2 kilometers (4.5 miles) before merging with the South Fork to form Cottonwood Creek, which then flows eastward into Fish Lake Valley, Nevada. Only one major tributary, Tres Plumas Creek, enters the North Fork of Cottonwood Creek approximately 1.6 kilometers (1.0 mile) above its mouth. From its headwaters at 3,096 meters (10,155 feet) to the mouth of Tres Plumas Creek at 2,784 meters (9,141 feet), the North Fork of Cottonwood Creek descends 312 meters (1,023 feet) in 5.6 kilometers (3.5 miles) (Wong 1975). The average gradient is 5.6 percent, greater than that of Silver King Creek (Ryan and Nicola 1976). Despite the high gradient, the streambed is composed predominantly of fine sediments. The relatively stable, spring-fed flows, together with a low frequency of flooding, are believed to be responsible for the high amount of fine sediments (Wong 1975). Mean stream width is 2.3 meters (7.5 feet) with a 1:1 ratio of pools and riffles (Wong 1975). Pool depths range between 0.3 and 2.0 meters (1 and 7 feet) (Wong 1975).

Wong (1975) describes the stream in three sections. The upper section flows through relatively flat stringer meadows with sections of heavy willow (*Salix* sp.) growth. The second section flows through a narrow canyon that increases the gradient, creating a series of cascades that form barrier falls 3 to 4 meters (10 to 13 feet) high. The stream is characterized by large boulders that create plunge pools and it is heavily overgrown with a tree canopy of aspen and understory of willow. The third section again flows through more meadows with low gradient, and willow dominates as stream cover. A 2.3-meter (7-foot) barrier is located 100 meters (330 feet) above the confluence with Tres Plumas Creek.

The climate of the Cottonwood Creek basin is cool and dry, as it is throughout the higher elevations of the White Mountains (Ryan and Nicola 1976). Studies in 1973 by Wong (1975) and in 1974 by Diana (1975) determined that the summer stream discharge ranges from 0.6 to 1.8 cubic feet per second, with daily maximum water temperatures ranging from 12 to 15.8 degrees Celsius (53.6 to 60.4 degrees Fahrenheit). Despite the abundance of spring-fed water sources, diurnal water temperatures varied as much as 10.5 degrees Celsius (18.9 degrees Fahrenheit). Limber pine (*Pinus flexilis*), aspen, and mountain mahogany (*Cercocarpus ledifolius*) are found in the drainage in addition to bristlecone pine

(*Pinus longaeva*), but on the whole, there are considerably fewer species of trees than in the Silver King Creek drainage.

As in Silver King Creek, beavers were introduced into the Cottonwood Creek drainage. A colony became established in the North Fork of Cottonwood Creek, primarily between the Granite Meadow tributary and the mouth of Tres Plumas Creek (Ryan and Nicola 1976). Efforts to eliminate beaver from the North Fork of Cottonwood Creek have been successful. However, grazing has occurred since the surrounding area was first settled. Originally, sheep were grazed, then beginning in 1923 only cattle were grazed.

3. Cabin Creek

Cabin Creek is a high elevation stream (3,200 meters [10,500 feet]) located 16 kilometers (10 miles) north of Cottonwood Creek in the White Mountains, Inyo National Forest, Mono County, California (Figure 2). Like Cottonwood Creek, Cabin Creek is small, flowing most of the year at less than 1 cubic foot per second. It flows south into Leidy Creek, which then flows eastward across the California-Nevada border into Fish Lake Valley. Dawne Becker (unpubl. data) characterizes Cabin Creek as a high gradient stream with many riffles, a few small pools, little spawning habitat, and poor winter habitat. The average gradient for the entire stream is 14.4 percent. The lower section of stream, from the confluence with Leidy Creek to about 3,000 meters (9,840 feet) elevation, has a gradient of 20.2 percent. The upper section of stream has an average gradient of 9.2 percent. Most of the stream is heavily vegetated with dense willows of all age classes with grasses, sedges (*Carex* sp.), and paintbrush (*Castilleja sp.*). Upland vegetation includes sagebrush, lupine (*Lupinus* sp.), and a few pine trees. Cabin Creek is within an active livestock grazing allotment. Some degradation of the riparian zone and stream is occurring from overutilization. Sloughing banks and trampling of tributary spring channels are causing increased sediment input.

4. Stairway Creek

Stairway Creek, Madera County, California, originates in two forks at 2,743 meters (9,000 feet) elevation and flows south into the Middle Fork San Joaquin River. The creek is located within the Ansel Adams Wilderness Area on the Sierra National Forest (Figure 3). Strand and Eddinger (1999) describe Stairway Creek based on a survey conducted in 1996. The survey focused on a 2.5-kilometer (1.6-mile) low gradient section of stream, just upstream of a 500-meter (1,640-foot) long section of stream with a greater than 40 percent gradient, above the confluence with the Middle Fork of the San Joaquin River. This section serves as a natural barrier to fish from downstream. A combination of A2 (greater than 4 percent gradient, confined channel, boulder substrate) and B3 (1 to 4 percent gradient, moderately confined channel, boulder/cobble substrate) Rosgen types (Rosgen 1996) describe this 2.5-kilometer (1.6-mile) reach. Using U.S. Forest Service Region 5 habitat typing methods (U.S. Forest Service 1996), 6 percent of the stream length was characterized as fast water while 94 percent was slow water. A breakdown of these data are summarized in Table 5. Channel stability (Pfankuch 1975) was rated "good" for all reaches sampled. Canopy cover was approximately 40 percent in the riparian zone, accounting for the low quantity of large woody debris, 3.3 pieces per 100 meters (328 feet), found in the stream.

A 650-meter (2,132-foot) Stream Condition Inventory (U.S. Forest Service 1996) reach was established in 2000 by Sierra National Forest personnel (P. Strand, unpubl. data), in order to monitor long-term habitat trends within Stairway Creek. This Stream Condition Inventory reach was within the 2.5-kilometer (1.6-mile) reach originally surveyed in 1996, and consisted of 41 percent (linear length) slow water habitats and 59 percent fast water habitats. Other information collected is summarized in Tables 6 and 7.

5. Sharktooth Creek

Sharktooth Creek exits Sharktooth Lake at 2,999 meters (9,836 feet). It is a headwater tributary to Fish Creek that flows northwest into the Middle Fork San Joaquin River, Fresno County, California. The creek is located within the John Muir Wilderness Area in the Sierra National Forest (Figure 3). Sharktooth Creek

Table 5. Summary of habitat survey on Stairway Creek conducted in 1996. All habitats were reduced to pool, riffle, or run based on data output from FISHHAB program (U.S. Forest Service R5 Version 2) (Strand and Eddinger 1999). See Rosgen (1996) for description of stream type.

Reach #	Stream Type	Length (meters)	Percent Pools	Percent Riffles	Percent Runs
1	A2	314	92	1	7
2	B3	269	32	11	57
3	A2a+	257	70	30	0
4	B3	747	26	6	68
5	A2a+	377	71	7	22
6	B2	121	31	0	69
7	A2	418	56	5	39
Mean			54	8	38

Table 6. Cross sectional data from 2000 survey of Stairway Creek (P. Strand, U.S. Forest Service, unpubl. data).

Cross Section	Gradient (percent)	Entrenchment (meters)	Width/Depth Ratio
1	2.4	2.0	23.0
2	0.53	8.8	25.0
Mean	1.46	5.4	24.0

Table 7. Transect data from 2000 survey of Stairway Creek (P. Strand, U.S. Forest Service, unpubl. data).

Transect Number	Bankfull Width (meters)	Depth (meters)	Width at 2X Bankfull Depth (meters)	Width/Depth Ratio	Entrenchment (meters)
5	6.35	0.35	12.0	18	1.9
10	5.05	0.40	50.5	13	10.0
15	5.35	0.35	8.5	15	1.6
20	9.05	0.43	74.2	21	8.0
25	9.95	0.28	11.5	36	1.16
30	6.7	0.31	9.0	22	1.3
35	7.75	0.37	62.0	21	8.0
40	6.0	0.34	7.0	18	1.17
45	11.55	0.33	14.0	35	1.21
50	7.05	0.37	14.0	19	2.0
Mean	7.48	0.35	26.27	21.8	3.63

is described by Strand and Eddinger (1999) as having high gradient sections that provide natural migration barriers. A 250-meter (820-foot) section of stream near the confluence with Lost Keys Lake outflow is described as a cascade/falls that has a gradient of 35 percent with large cobble and boulders as substrate. Upstream of this point a step-pool sequence develops as the gradient reduces to less than 15 percent. Then comes a low gradient (less than 2 percent) section, approximately 1,565 meters (5,133 feet) in length, that is described in greater detail below. Above this section, the stream again increases in gradient to the outflow of Sharktooth Lake.

A Stream Condition Inventory (U.S. Forest Service 1996) reach was established in 1999 by Sierra National Forest personnel on the lower gradient middle section (approximately 1,565 meters [5,133 feet]) of Sharktooth Creek (Strand and Eddinger 1999), in order to monitor long-term habitat trends within Sharktooth Creek. This section of stream was a Rosgen type C3 (less than 2 percent gradient, well developed floodplain, mostly cobble with lesser amounts of gravel and sand, Table 8), and included 205 pieces of large woody debris with 7 aggregations, and stream shading was 71 percent, which indicates that the riparian area is dominated by large woody species of trees. Sixty percent of the stream length was characterized as fast water (riffles, cascades, and step-pools) while 40 percent was slow water (pools, glides and runs). Bank stability was 75 percent or greater for all 50 transect points, which are considered good ratings (U.S. Forest Service 1996). The mean temperature was 12 degrees Celsius (54 degrees Fahrenheit) with a pH of 7 and a dissolved oxygen reading of 10.4 milligrams per liter. These water quality data indicate that Sharktooth Creek does not have any water quality deficiencies for Paiute cutthroat trout, which require cool, well oxygenated water for all life stages. Table 8 shows cross section data while Table 9 provides transect data.

Table 8. Cross sectional data from 1999 survey of Sharktooth Creek (Strand and Eddinger 1999).

Cross Section	Gradient (percent)	Entrenchment (meters)	Width/Depth Ratio
1	1.64	2.15	11.12
2	1.37	3.17	19.25
3	1.19	6.52	14.37
Mean	1.4	3.95	14.91

Table 9. Transect data from 1999 survey of Sharktooth Creek (Strand and Eddinger 1999).

Transect Number	Bankfull Width (meters)	Depth (meters)	Width at 2X Bankfull Depth (meters)	Width/Depth Ratio	Entrenchment (meters)
5	8.6	0.32	> 30	26.87	3.49
10	3.1	0.41	8.1	7.52	2.61
15	3.3	0.45	14.65	7.33	4.44
20	3.21	0.12	7.79	26.75	2.43
25	4.25	0.19	9.1	22.37	2.14
30	4.2	0.3	9.8	14	2.33
35	3.08	0.24	7.05	12.83	2.29
40	2.7	0.12	4.1	22.5	1.52
45	5.95	0.37	8.05	16.08	1.35
50	3.1	0.64	8.85	4.84	2.85
Mean	4.15	0.32	10.75	16.11	2.55

H. Reasons for Listing and Current Threats

Species are placed on the endangered species list based on one or more of the five listing factors for Federal listing of a species in section 4(a)(1) of the Endangered Species Act. The five listing factors are: (1) The present or threatened destruction, modification, or curtailment of habitat or range; (2) Overutilization for commercial, recreational, scientific, or educational purposes; (3) Disease or predation; (4) Inadequacy of existing regulatory mechanisms; and (5) Other natural and manmade factors affecting the species' continued existence. The Paiute cutthroat trout was listed as endangered on October 13, 1970 (U.S. Fish and Wildlife Service 1970) and reclassified to threatened on July 16, 1975 to facilitate management and allow regulated angling (U.S. Fish and Wildlife Service 1975). Threats at the time of reclassification included livestock grazing, recreational development, and hybridization from rainbow trout introduction. Appendix A delineates the relationships between threats, recovery actions that address them, and recovery criteria. Existing threats are as follows:

(1) The present or threatened destruction, modification, or curtailment of habitat or range.

Valuable cover for stream populations of cutthroat trout is provided by undercut banks, which are dependent on extensive vegetative cover for their stability (Behnke and Zarn 1976). Streambank sloughing occurs as the result of normal erosive forces (floods, channel realignment, etc.) but can be accelerated by human-caused activities (off-highway vehicle use, grazing, logging, etc.). Heavy recreation, such as use by anglers and backpackers, can also result in streambank degradation. Streambank sloughing results in the loss of instream cover, increased water temperatures, streambed sedimentation, elimination of spawning habitat, and reduced food supplies, and can retard the growth of willows and aspen along the stream bank (Armour *et al.* 1994; Bohn and Buckhouse 1985; Duff 1977; Kauffman *et al.* 1983a, 1983b; Marlow and Pogacnik 1985; and Meehan and Platts 1978).

Cattle last grazed the Silver King Basin during the summer of 1994. On March 31, 1995, all authorized grazing on the Silver King Allotment was placed under administrative rest and the allotment is currently vacant. It will remain

vacant unless appealed and upheld under the administrative appeal process. The Cottonwood Creek and Tres Plumas allotments in the North Fork of Cottonwood Creek also have the potential to affect Paiute cutthroat trout habitat (Kondolf 1994). Grazing was suspended for both these allotments in 2000, and will be in non-use status for at least 10 years in the Cottonwood Basin (D. Hubbs, U.S. Forest Service, pers. comm. 2002). Cabin Creek is within an active grazing allotment and some degradation of habitat is occurring due to bank failure and increased sediment input. Grazing does not currently affect occupied habitat in Stairway and Sharktooth Creeks due to the inaccessibility of the area to livestock (P. Strand, pers. comm. 2003).

Beavers have been a past threat to Paiute cutthroat trout because they degrade spawning substrates and water quality. Beavers were introduced to the east slope of the Sierra Nevada (Ingles 1965). Willow and aspen growth along Silver King Creek and its tributaries, and the North Fork of Cottonwood Creek is not adequate to support a permanent beaver colony. When beavers colonize an area, as they did in upper Silver King Creek, they remove the aspen faster than it can be regenerated. Consequently after a short period, the beavers are forced to move on to other areas in search of food. After the beavers move out, the abandoned dams and lodges wash out, and the fine silt and sand from the dams is eroded and deposited in the streambed. The collapse of old beaver dams, and associated down-cutting in Four Mile Canyon Creek has caused degradation of that stream habitat. This series of events led to a 10-fold decline in the population (Ryan *in litt.* 1982).

(2) Overutilization for commercial, recreational, scientific, or educational purposes.

Paiute cutthroat trout are susceptible to unregulated angling. Connell (letter in Ryan and Nicola 1976) reported that in 1890 he and a companion took 1,500 fish from Silver King Creek in only 3 days of fishing. He noted that "...they fished only a very small part of the time" and that their angling success was enhanced when his fishing companion " ...conceived the idea of putting two hooks on his line and succeeded in bringing out two fish in the majority of his casts". From 1952 to 1965, Silver King Creek was open to angling to reduce the number of hybrid fish and the population above Llewellyn Falls was severely

depleted. Angling has been closed in Silver King Creek above Llewellyn Falls since 1965. In the early 1970's, the population above the Falls was again significantly reduced following a brief period of unauthorized angling by military personnel (Ryan and Nicola 1976). Currently, overutilization for commercial, scientific, or educational purposes is not occurring.

(3) Disease or predation

There are several natural predators (water shrews [*Sorex palustris*], dippers [*Cinclus mexicanus*], and trichopteron larvae) on Paiute cutthroat trout eggs and fry, but few on adult fish. Predation does not seem to be a significant threat at this time.

Disease is apparently a significant cause of adult mortality in the North Fork of Cottonwood Creek, particularly in the post-spawning period. Wong (1975) observed extensive fungal infections on the dorsal and caudal fins of several spawned-out fish in the North Fork of Cottonwood Creek. Many of these fish were so weakened by spawning that they were unable to recover. Few Paiute cutthroat trout apparently live beyond the age of 3 in a wild stream environment (Wong 1975). This disease has not been observed outside of the North Fork of Cottonwood Creek.

(4) Inadequacy of existing regulatory mechanisms.

Existing regulatory mechanisms appear to be adequate at this time. However, agency commitments to recovery actions may be limited due to budgetary constraints.

(5) Other natural and manmade factors affecting the species' continued existence.

In the early part of the twentieth century, Paiute cutthroat trout were eliminated from their presumed historic habitat through hybridization with introduced rainbow trout, golden trout, and Lahontan cutthroat trout. Stocking records from 1930 to 1953 document the plantings of thousands of nonnative salmonids within the Silver King Basin. Nonnative salmonids continue to occupy all of the historic habitat of the Paiute cutthroat trout.

Effective fish barriers are needed to keep other trout from invading Paiute cutthroat trout waters. Even with effective barriers, there is an ever-present risk that other trout will be introduced above the barriers by humans. Due to the proximity of nonnative fish below Llewellyn Falls, the threat of an unauthorized introduction of fish from below this area will remain until nonnative fish are removed and Paiute cutthroat trout are reestablished below the falls. This action will isolate Paiute cutthroat trout within the Silver King Basin because the Silver King Canyon contains several barriers that will prevent salmonids from migrating upstream. The Silver King Canyon is also difficult to access, which should discourage humans from moving other trout above the barriers into historical Paiute cutthroat trout habitat. The pre-1973 contamination of a portion of the North Fork of Cottonwood Creek population was apparently the result of an unauthorized trout introduction.

Paiute cutthroat trout have a distinctive evolutionary history that complicates management efforts to recover this fish. Paiute cutthroat trout evolved in isolation from other fish species, and accordingly faced substantially different selection pressures than most other North American salmonids. As a consequence, this subspecies has developed behavioral traits that render its prospects for coexisting with potential competitors highly unlikely. In those situations where other salmonids have invaded Paiute cutthroat trout habitats, the Paiute cutthroat trout have eventually been displaced. When associated with Lahontan cutthroat trout or rainbow trout, the Paiute cutthroat trout tend to lose their distinctiveness through introgressive hybridization. When associated with brook trout, Paiute cutthroat trout tend to be displaced by competition (Schroeter 1998).

The Paiute cutthroat trout faces several threats to its existence because of its limited distribution and its susceptibility to displacement by other salmonids. Several events have occurred in the past to imperil its existence, including: 1) the early introduction of rainbow trout and Lahontan cutthroat trout into the Silver King Creek drainage and subsequent introgression; 2) the introduction of beavers into the Silver King Creek drainage; 3) the occurrence of a flood in Silver King Creek that may have eliminated a natural barrier and allowed nonnative salmonids to enter the drainage; 4) the degradation of habitat caused by livestock grazing and off-highway vehicle use in the North Fork of Cottonwood Creek; and (5)

excessive angling. Its extremely limited distribution makes it vulnerable to extinction in the event of a large disturbance (Dunham *et al*. 2003; Miller *et al*. 2003). Dunham *et al*. (2003) report that the degree to which fish are affected by a disturbance, such as fire, is related to the quality of the habitat before the disturbance, the quantity and distribution of habitat (habitat fragmentation), and the habitat requirements of the species impacted by the disturbance. The Paiute cutthroat trout population in Silver King Creek, once it becomes re-established throughout its native range, will be less susceptible than the out-of-basin populations due to the size of the drainage, the size of the population, and the quality and distribution of habitat in which it evolved.

I. Conservation Efforts

All Paiute cutthroat trout habitat is publicly owned. Silver King Creek and its tributaries are situated within the Humboldt-Toiyabe National Forest, the North Fork of Cottonwood Creek and Cabin Creek are located within the Inyo National Forest, and Stairway and Sharktooth Creeks lie within the Sierra National Forest. Silver King Creek and its tributaries are within the Carson-Iceberg Wilderness, Stairway Creek is within the Ansel Adams Wilderness, and Sharktooth Creek is within the John Muir Wilderness. The California Department of Fish and Game, with cooperation from us and the Humboldt-Toiyabe National Forest, has proposed activities intended to extend the range of Paiute cutthroat trout in Silver King Creek downstream of Llewellyn Falls to the Silver King Canyon during the fall of 2004.

Previous management efforts to protect and restore the Paiute cutthroat trout have primarily involved: 1) mechanical and chemical treatments to remove competing or introgressed fish; 2) transplants to restore fish populations in fishless waters; 3) land exchanges to secure essential habitat; 4) fishing closures; and 5) fish habitat restoration projects.

Paiute cutthroat trout have been introduced into several lakes and streams within and outside their native range (Table 1). Self-sustaining populations have been established in Silver King Creek above Llewellyn Falls, Fly Valley Creek, Corral Valley Creek, Coyote Valley Creek, and Four Mile Canyon Creek in the Silver King Creek drainage. Self-sustaining populations have also been

established in the North Fork of Cottonwood Creek, Stairway Creek, Sharktooth Creek, and Cabin Creek. The introduced population in Delaney Creek is suspected to be extirpated due to the presence of brook trout; however, no recent surveys have been conducted. The 1983 introduction of Paiute cutthroat trout into Heenan Reservoir was made to establish a broodstock for artificial propagation. This population no longer exists.

Corral Valley and Coyote Valley Creeks were treated in 1964 and 1977 respectively, to remove nonnative and hybrid trout. Electrofishing efforts eliminated surviving hybrid trout and genetic analysis indicates that Corral Valley Creek now contains pure Paiute cutthroat trout (Israel *et al.* 2002). The single year treatment failed in Coyote Valley Creek because fish that survived above the treatment area repopulated downstream meadow reaches. Coyote Valley Creek was retreated during 1987 and 1988. Both Corral and Coyote Valley Creeks were restocked from Fly Valley Creek following treatments. Surveys and genetic analysis following the most recent treatments have not detected the presence of introgressed fish in either stream.

Silver King Creek was restocked from Coyote Valley and Fly Valley Creeks from 1994 through 1998, in various locations between the downstream end of Upper Fish Valley, upstream to the confluence of Fly Valley Creek. Additionally, Paiute cutthroat trout likely dispersed downstream from Fly Valley and Four Mile Canyon Creeks, which contributed to the population reestablishing. Annual snorkel surveys of Silver King Creek have revealed that substantial recruitment and multiple age classes had developed in the Paiute cutthroat trout population by 1997, and total numbers exceeded 400 fish during 1999.

Beaver control and habitat restoration were accomplished during the early to mid- 1980's in the Silver King Creek drainage above Llewellyn Falls and in the North Fork of Cottonwood Creek. Beavers have been extirpated in the vicinity of the confluence of Fly Valley Creek with Silver King Creek and also in Four Mile Canyon Creek. Beaver dams were subsequently breached in both locations. Extensive stream habitat restoration work, including rerouting the stream channel, was accomplished in Four Mile Canyon Creek. Beaver were noted in past years to occur in Tamarack and Snodgrass Creeks. No recent beaver activity has been

observed in Tamarack or Snodgrass Creeks, however, the potential for recolonization throughout the drainage remains a concern.

In 1971, the Humboldt-Toiyabe National Forest completed a land exchange with the Sierra Pacific Power Company to secure management protection for most of the upper Silver King Creek watershed. The California Department of Fish and Game acquired 290 hectares (720 acres) in the vicinity of Poison Flat during 1990 for protection of Lahontan cutthroat trout, which also provides watershed protection for Silver King Creek. In 1963, the U.S. Marine Corps agreed to discontinue use of the watershed for survival training. In 1984, the Toiyabe National Forest and the California Department of Fish and Game rerouted lower Fly Valley Creek back into a historic channel to reduce sedimentation from a large headcut that was moving through a series of old beaver dams. Four Mile Canyon Creek was similarly rerouted from old beaver dams, and various habitat projects were performed to stabilize the streambanks and provide fish habitat during 1988 and 1989. Fish habitat improvement structures and bank protection projects were constructed in Silver King Creek during 1988. Cattle exclosure electric fences were constructed and maintained during 1985 through 1994 in both Silver King and Coyote Valley Creeks. These fenced exclosure areas protected stream reaches from grazing, and provided reference stream reaches to evaluate grazing impacts in the unfenced reaches.

Paiute cutthroat trout are managed by the State of California under the 4(d) rule published in 1975, which states that Paiute cutthroat trout can be taken in accordance with applicable State law and that violation of State law will also be a violation of the Endangered Species Act (Code of Federal Regulations Title 50, Section 17.44). Silver King Creek and its tributaries above Llewellyn Falls are closed to angling. Angling closures have also been established to protect the populations in Coyote Valley Creek, Corral Valley Creek, and the North Fork of Cottonwood Creek. Stairway Creek, Cabin Creek, and Sharktooth Creek are all relatively inaccessible and lightly used, and therefore are managed as wild trout fisheries without special protective regulations. The California Department of Fish and Game and the U.S. Forest Service have periodically maintained a stream guard in upper Silver King Creek to enforce the angling closure above Llewellyn Falls. The Inyo National Forest prepared a habitat management plan for Paiute cutthroat trout in 1991. That plan includes several projects to improve habitat

quality in the Cottonwood Creek basin. The actions proposed in the habitat management plan are compatible with the objectives of this recovery plan.

II. RECOVERY

A. Objective and Criteria

The objective of this recovery plan is to improve the status and habitat of the Paiute cutthroat trout so it can be delisted. Criteria for accomplishing the goal of delisting are:

1. All nonnative salmonids are removed in Silver King Creek and its tributaries downstream of Llewellyn Falls to fish barriers in Silver King Canyon;

2. A viable population occupies all historic habitat in Silver King Creek and its tributaries downstream of Llewellyn Falls to fish barriers in Silver King Canyon;

3. Paiute cutthroat trout habitat is maintained in all occupied streams;

4. The refuge populations in Corral and Coyote Creeks, Silver King Creek, and tributaries above Llewellyn Falls as well as out-of-basin populations are maintained as refugia and are secured from the introduction of other salmonid species; and

5. A long-term conservation plan and conservation agreement are developed, which will be the guiding management documents once Paiute cutthroat trout are delisted.

Specifications for these recovery criteria are discussed in greater detail below (section II.B).

Because this recovery plan is partially focused on habitat improvements, it also provides conservation benefits for two candidate species, the Sierra Nevada population of the mountain yellow-legged frog and the Yosemite toad.

B. Recovery Strategy

The primary threat to the Paiute cutthroat trout is hybridization with nonnative trout, compounded by its extremely limited distribution (making it vulnerable to catastrophic events). Consequently, it is critical to remove nonnative trout from the historic range downstream of Llewellyn Falls and reestablish Paiute cutthroat trout populations there, monitoring population abundance and genetics to evaluate success. Reinvasion of Paiute cutthroat trout habitat by nonnative trout should be prevented by monitoring or establishing instream barriers and discouraging deliberate introductions. Because the Paiute cutthroat trout is vulnerable to angling pressure, appropriate fishing regulations and closures should be maintained and enforced by a stream guard and signage. Potential habitat degradation should be addressed by appropriate fish habitat improvement actions, including management of recreational access and grazing, and control of beaver populations as necessary. The recovery criteria above should be met by addressing these threats, as detailed below.

Meeting the first and second recovery criteria will secure long-term protection and population viability of Paiute cutthroat trout by their expansion within their native range. This range expansion will be accomplished by removing nonnative trout from the Silver King Creek drainage from Llewellyn Falls downstream to the Silver King Canyon, including tributaries, followed by reintroduction with Paiute cutthroat trout from donor tributaries best suited as determined by genetic testing (Israel *et al*. 2002). A viable population will be achieved when the population is stable or increasing in size and comprising three or more age classes for 5 years, and consisting of a minimum of 2,500 fish greater than 75 millimeters (3 inches) (Hilderbrand and Kershner 2000). This figure is a preliminary estimate and may need to be revised as additional information becomes available.

The third recovery criterion is to maintain suitable habitat for Paiute cutthroat trout. Historic and occupied Paiute cutthroat trout stream and riparian habitat should have no degradation from existing conditions due to anthropogenic effects. The condition of existing habitat will be identified using established stream habitat monitoring protocols which use measurable and repeatable methods (see section I.G above and Appendix A). Beaver control will need to be

conducted in the event that they repopulate the drainage. To secure the protection of the North Fork Cottonwood population, a second barrier will be needed to protect the population from the introduction of nonnative trout species from downstream. Cabin Creek is within an active grazing allotment where continued management will be necessary to ensure degradation of Paiute cutthroat habitat does not occur. Stairway and Sharktooth Creeks are subject to limited human disturbance since they are in designated wilderness areas, are inaccessible to livestock, and get limited recreational use. Therefore, habitat monitoring should be done periodically to document stochastic events such as a rain on snow event which occurred in 1997 (P. Strand, pers. comm. 2002).

The fourth recovery criterion is to protect and enhance Paiute cutthroat trout that do not occupy historic habitat. To protect against a catastrophic event that could affect the entire Silver King Creek gene pool, populations in Corral Valley and Coyote Valley Creeks, Silver King Creek and tributaries (Four Mile Canyon, Fly Valley, and Bull Canyon Creeks) above Llewellyn Falls, and the four out-of-basin populations must be maintained as Paiute cutthroat trout refugia. Monitoring these populations will aid in management decisions aimed to maintain and improve the abundance of Paiute cutthroat trout and collection of long-term trend data. Continued genetic monitoring of all populations of Paiute cutthroat trout will be used to: 1) monitor population genetic diversity; 2) evaluate effective population size and reproductive isolation; 3) examine populations for evidence of hybridization; and 4) identify appropriate donor sources.

The fifth and final criterion is to develop a long-term conservation plan and conservation agreement that will guide the agencies responsible for the management of Paiute cutthroat trout after it is delisted. The purpose of the conservation plan is to ensure that adequate regulatory mechanisms and management programs remain in existence after delisting to ensure that all populations of Paiute cutthroat trout and their habitat are maintained. The conservation plan will be consistent with other existing cutthroat trout subspecies conservation plans. The purpose of the conservation agreement is to define the role of the management agencies and to document their commitment to implementing the conservation plan. The conservation plan and conservation agreement will need to be approved and signed by all responsible agencies before delisting occurs.

Prior to implementation of any task in this plan, the lead Federal agency must comply with all applicable provisions of the National Environmental Policy Act and the Endangered Species Act. All necessary Federal, State, and local permits or authorizations must be obtained. These recovery criteria were designed to provide a basis for consideration of delisting, but not for automatic delisting. Before delisting occurs, we must determine that the five listing factors (as discussed previously) no longer are present or continue to adversely affect the listed species. The final decision regarding delisting will be made only after a thorough review of all relevant information. It is our goal to achieve recovery as quickly as possible while minimizing social and economic impacts.

C. Narrative Outline of Recovery Actions

1. Remove nonnative fish from Silver King Creek downstream from Llewellyn Falls to barriers in Silver King Canyon. Hybridization, which has occurred within and outside the native drainage, continues to be a threat. Chemically treat Silver King Creek to remove all introgressed fish downstream from Llewellyn Falls to barriers in Silver King Canyon, including all tributaries that enter the mainstem in this reach. In addition, Tamarack Lake, which was formerly stocked with trout in 1991, must be treated to remove any remaining fish. Tamarack Lake will remain fishless for the benefit of amphibian species.

2. Reintroduce Paiute cutthroat trout into renovated stream reaches in historic habitat. The most effective means of insuring that the Silver King population remains above critical minimum levels is by expanding the population downstream into historical habitat. Franklin (1980) recommended an effective population size of at least 500 individuals to maintain adequate long-term genetic variation. Hilderbrand and Kershner (2000) suggested that 2,500 individuals may be necessary to maintain cutthroat populations in small streams. This estimate is preliminary and may need to be revised as additional information becomes available. Restock Silver King Creek below Llewellyn Falls with pure Paiute cutthroat trout within 1 year after the final chemical treatment. Restocking may need to be continued for several years to enhance recolonization. The fish used for restocking should be taken from

populations based on results from genetic analysis and will be mixed with other populations, as necessary, to promote genetic heterozygosity (Israel *et al*. 2002). Expansion of Paiute cutthroat trout downstream from Llewellyn Falls will provide additional protection from the potential unauthorized introduction of non-native trout.

3. Protect and enhance all occupied Paiute cutthroat trout populations. Habitats have been improved through livestock grazing closures and eradication of beavers. Historic and occupied Paiute cutthroat trout stream and riparian habitat should have no degradation from existing conditions due to anthropogenic effects. Existing habitat will be identified using established stream and riparian habitat monitoring protocols which use measurable and repeatable methods. Ongoing monitoring will be necessary to detect recolonization of beaver within Paiute cutthroat trout habitats. In addition, various types of habitat protection and restoration measures are needed to maintain populations at levels that are high enough to avoid the adverse effects associated with inbreeding depression. Several actions are needed to maintain or restore habitat conditions to the levels needed to support recovery.

   3.1 Restore and maintain riparian habitat quality and stream channels in the Silver King Creek drainage. Recreation, livestock, and beaver have degraded habitat conditions in the Silver King basin. Paiute cutthroat trout evolved in an isolated headwater environment. They require good water quality and clean spawning gravel to survive. The most favorable habitat is provided by streams with undercut or overhanging banks and abundant riparian vegetation. Several management activities are needed to improve Silver King basin streams.

      3.1.1 Institute a habitat monitoring program. Institute a stream and riparian habitat monitoring program which uses an established stream monitoring protocol with measurable and repeatable methods.

3.1.2 Monitor and manage the amount of recreational trail and campsite use adjacent to occupied habitats. Bank conditions must be monitored and managed to prevent physical damage to banks and associated riparian vegetation. Trails and campsites should be relocated away from streams in areas where stream-side degradation is occurring.

3.1.3 Protect Paiute cutthroat trout habitat from effects of grazing. Continue to exclude grazing in Silver King Creek drainage.

3.1.4 Conduct periodic surveys to detect reinvasion by beavers. Periodic surveys should be made to detect beavers that migrate to the Silver King Creek drainage from other areas before they construct dams that create barriers to fish migration and become sources of future streambed sedimentation.

3.1.5 Remove beavers from watershed and dismantle dams and lodges if any are built. Beavers can severely degrade areas, such as Silver King Creek, that do not have adequate aspen or willow growth. Whenever they are discovered in the Silver King Creek drainage, they should be removed and the dams and lodges that have been built should be dismantled.

3.1.6 Develop and implement solutions for other identified habitat problems. If conflicting land uses are identified and problems develop, solutions to the problems should be developed and remedies implemented to provide habitat recovery.

3.2 Restore and maintain stream banks, riparian vegetation, and stream channels in the North Fork of Cottonwood Creek drainage. Habitat conditions in the North Fork of Cottonwood Creek

drainage are generally good, but localized damage has occurred in some areas as the result of beaver use and past human activities.

Management activities will be required to maintain and/or improve habitat in portions of the North Fork of Cottonwood Creek. Stream reaches that support Paiute cutthroat trout should be periodically monitored to maintain existing habitat conditions using an established stream monitoring protocol with measurable and repeatable methods.

3.2.1 Conduct periodic habitat surveys. Conduct habitat surveys to determine if there are any potential sources of habitat degradation, including but not limited to stream sedimentation, stream bank stability, or riparian conditions.

3.2.2 Establish off-highway vehicle barriers at existing and potential access points. Off-highway vehicles pose a threat to Paiute cutthroat trout by: 1) directly degrading habitat when crossing streams and creating new sources of erosion; and 2) providing anglers with easier access to Paiute cutthroat trout streams. Existing road closures should be strictly enforced and new barriers constructed if they are needed to restrict access.

3.2.3 Protect Paiute cutthroat trout habitat from effects of grazing. Continue to limit grazing in the North Fork Cottonwood drainage. If grazing is allowed, cattle should be excluded from all riparian areas and appropriate grazing strategies implemented.

3.2.4 Set and enforce dispersed and developed recreational use limits. Directing large numbers of recreational users to North Fork of Cottonwood Creek would inevitably stimulate unauthorized angling for Paiute cutthroat trout. Because Paiute cutthroat trout are currently present in very low numbers and are extremely vulnerable to angling,

recreational access to the basin should be maintained at appropriate levels.

3.2.5 Conduct periodic surveys to detect reinvasion by beavers. Periodic surveys should be made to detect beavers that migrate back to North Fork Cottonwood Creek from other areas so they can be removed before they construct dams that create barriers to fish migration and become sources of future streambed sedimentation.

3.2.6 Remove beavers from the watershed and dismantle dams and lodges. Whenever beavers are discovered in North Fork Cottonwood Creek, they should be removed and the dams and lodges they have built should be dismantled.

3.2.7 Construct a second barrier on North Fork Cottonwood Creek. The existing pure population in the North Fork of Cottonwood Creek is now restricted to the upper 5.5 kilometers (3.4 miles) above a natural barrier. A second barrier is necessary to secure the population from reinvasion of nonnative trout species.

3.2.8 Develop and implement solutions for other identified habitat problems. If conflicting land uses are identified and problems develop, solutions to the problems should be developed and remedies implemented to provide habitat recovery.

3.3 Maintain stream and riparian habitat quality in Stairway, Sharktooth, and Cabin Creeks. Habitat conditions in the Stairway and Sharktooth Creek drainages are generally very good, and future management needs will be limited to maintaining existing conditions. Cabin Creek is within an active grazing allotment where continued management will be necessary to ensure degradation of Paiute cutthroat trout habitat does not occur.

Stream reaches that support Paiute cutthroat trout should be periodically monitored to maintain existing habitat conditions using an established stream monitoring protocol with measurable and repeatable methods.

3.3.1 Conduct periodic habitat surveys. Conduct habitat surveys of each stream to determine if there are any potential sources of habitat degradation, including but not limited to stream sedimentation, stream bank stability, or riparian conditions.

3.3.2 Protect Paiute cutthroat trout habitat from effects of grazing in Cabin Creek. Implement a grazing strategy that will protect occupied habitat from the effects of grazing in the Cabin Creek drainage.

3.3.3 Develop and implement solutions for other identified habitat problems. If conflicting land uses are identified and problems develop, solutions to the problems should be developed and remedies implemented to provide habitat recovery.

4. Continue to monitor and manage existing and reintroduced populations. The number of fish in the existing populations must be stable or increasing. Monitoring of Paiute cutthroat trout populations should track population abundance and composition, identify any hybridization, assess barrier integrity, and maintain genetic heterozygosity.

4.1 Enforce all laws and regulations protecting the Paiute cutthroat trout and its habitat, and periodically review their effectiveness. All laws and regulations that provide protection for Paiute cutthroat trout must be enforced. Enforcement personnel from all agencies should be given maps denoting the location of all populations within their area of responsibility. These personnel should also be advised of the types of activities most likely to be detrimental to the Paiute cutthroat trout.

4.1.1 Maintain a seasonal guard in upper Silver King Creek. Because of the extreme susceptibility of Paiute cutthroat trout to angling pressure, a seasonal guard should be hired to insure that the angling regulations above Llewellyn Falls in Silver King Creek are properly enforced.

4.1.2 Prevent exotic fish introductions into Paiute cutthroat trout waters. Paiute cutthroat trout have been displaced from several streams and lakes because of unauthorized introductions of nonnative trout. This threat will always exist, but several actions can be taken to minimize the risk. Packers and recreational users should be informed and educated on the distinctiveness of the Paiute cutthroat trout and advised of the consequences an unauthorized transplant would have on existing populations and on their opportunities to use the affected streams in the future.

4.2 Review existing laws and regulations and propose necessary changes. The Paiute cutthroat trout is unwary and therefore, highly vulnerable to angling. Consequently, restrictive regulations are necessary to maintain viable populations. The opportunity for a highly regulated and special designation fishery above Llewellyn Falls should be explored during the non-native fish eradication described under Recovery Action 1. No fishing should be allowed in the North Fork of Cottonwood Creek. Explore additional out-of-basin population locations.

4.3 Maintain viable, genetically pure populations in Silver King Creek. A variety of actions are needed to maintain the genetic integrity of the existing populations in Silver King Creek. Baseline and follow-up surveys are needed to ensure population levels are stable or increasing and that other trout species have not invaded Paiute cutthroat trout waters.

4.3.1 Monitor abundance and age class composition. Annually survey test sections to assess population size, determine age class composition, and monitor the condition of the different populations within the Silver King Creek drainage.

4.3.2 Evaluate the potential for occurrence of hybrid trout. Conduct annual surveys until population levels reach or exceed recovery plan objectives. Subsequent surveys should be conducted periodically to identify unauthorized introductions of other trout species. Surveys should include appropriate genetic analysis to detect hybrid individuals. If hybrids are discovered, appropriate action should take place.

4.3.3 Assess integrity of barriers. Periodically inspect all fish barriers in the Silver King Creek drainage to ascertain their effectiveness in preventing other fish species from invading Paiute cutthroat trout habitats.

4.3.4 Mix populations in the Silver King drainage as necessary to maintain genetic diversity. If it is determined that any of the populations in the Silver King drainage suffer from inbreeding depression or the long-term depletion of genetic variance, they may be mixed with other populations to promote genetic heterozygosity.

4.3.5 Develop and implement actions, as needed, to protect genetic integrity. Take action and develop solutions to protect the genetic integrity of these populations if threats are identified.

4.4 Maintain viable, genetically pure populations in the North Fork of Cottonwood Creek. The North Fork of Cottonwood Creek is a necessary refuge for Paiute cutthroat trout in the event of a catastrophic occurrence in the Silver King Creek drainage. It is

also important because it will help secure the genetic diversity of other Paiute cutthroat populations. A variety of actions are needed to maintain the genetic integrity of the existing population. Baseline and follow-up surveys are needed to ascertain if population levels are stable or increasing, critical fish barriers are intact, and to ensure that other trout species have not invaded Paiute cutthroat trout waters.

4.4.1 Monitor abundance and age class composition. Periodically survey test sections to assess population size, determine age class composition, and monitor the condition of the different populations.

4.4.2 Evaluate the potential for occurrence of hybrid trout. Conduct periodic surveys to look for unauthorized introductions of other trout species. Surveys should include appropriate genetic analysis to detect hybrid individuals. If hybrids are discovered, appropriate action should take place.

4.4.3 Assess integrity of barriers. Periodically inspect all fish barriers in the drainage to ascertain their effectiveness in preventing other fish species from invading Paiute cutthroat trout habitats.

4.4.4 Mix populations in North Fork Cottonwood Creek as necessary to maintain genetic diversity. If it is determined that the population in North Fork Cottonwood Creek suffers from inbreeding depression or the long-term depletion of genetic variance, they may be mixed with other populations to promote genetic heterozygosity.

4.4.5 Develop and implement actions, as needed, to protect genetic integrity. Take action and develop solutions to protect the genetic integrity of this population if threats are identified.

4.5 Maintain viable, genetically pure populations in Stairway, Sharktooth and Cabin Creek drainages. The remote locations of Stairway, Sharktooth and Cabin Creeks make them excellent refuge habitats for the Paiute cutthroat trout. Maintaining the existing population should require only modest management efforts because of their remote locations.

4.5.1 Monitor abundance and age class composition. Periodically survey test sections to assess population size, determine age class composition, and monitor the condition of the different populations.

4.5.2 Evaluate the potential for occurrence of hybrid trout. Conduct periodic surveys to look for unauthorized introductions of other trout species. Surveys should include appropriate genetic analysis to detect hybrid individuals. If hybrids are discovered, appropriate action should take place.

4.5.3 Assess integrity of barriers. Periodically inspect fish barriers in each stream to ascertain their effectiveness in preventing other fish species from invading Paiute cutthroat trout habitats.

4.5.4 Mix populations in Stairway, Sharktooth, and Cabin Creeks as necessary to maintain genetic diversity. If it is determined that any of the populations in Stairway, Sharktooth, or Cabin Creeks suffer from inbreeding depression or the long-term depletion of genetic variance, they may be mixed with other populations to promote genetic heterozygosity.

4.5.5 Develop and implement actions, as needed, to protect genetic integrity. Take action and develop solutions to

protect the genetic integrity of these populations if threats are identified.

4.6 Explore additional out-of-basin locations. Because Paiute cutthroat trout have a very limited range and refuge populations are in isolated drainages susceptible to stochastic and anthropogenic disturbances, it may be useful to increase the number of refuge populations.

5. Develop a long-term conservation plan and conservation agreement. A conservation plan for the long-term management of Paiute cutthroat trout and a conservation agreement between all involved agencies must be developed before the species can be delisted. The purpose of the conservation plan is to ensure that adequate regulatory mechanisms and management programs remain in existence after delisting to ensure that all populations of Paiute cutthroat trout and their habitat are maintained. The purpose of the conservation agreement is to define the role of the management agencies and to document their commitment to implementing the conservation plan.

5.1 Develop a long-term conservation plan. A conservation plan should be prepared that will incorporate all the information obtained through the completion of the recovery plan actions. All agencies will need to maintain records on their recovery activities and provide pertinent information in development of the conservation plan. The conservation plan will need to provide pertinent biological and management information on the Paiute cutthroat trout for use in maintaining Paiute cutthroat trout populations. It must identify how populations will be monitored to document the status and condition of populations and habitats, and will identify conditions that would warrant relisting the Paiute cutthroat trout. The conservation plan should be developed and approved through the conservation agreement by all agencies with management jurisdiction over Paiute cutthroat trout populations before the species is delisted.

5.2 Develop a conservation agreement. A conservation agreement should be approved and signed by all involved agencies with Paiute cutthroat trout populations on areas under their jurisdiction to document their approval and commitment to implementing the conservation plan.

6. Inform the public of Paiute cutthroat trout recovery objectives and pertinent management activities. Existing and prospective public users of the areas that support Paiute cutthroat trout populations should be informed about the Paiute cutthroat trout recovery effort, and should be notified of activities, such as chemical treatments, that may temporarily restrict their use of an area. Packers and other recreational users should be informed of the consequences that unauthorized angling or "coffee-can" transplants will have on the integrity of pure populations and on future recreational opportunities.

6.1 Manufacture and post informational signs. Informational signs should be installed at public access areas, and interested individuals and organizations should be notified of management activities that might affect their use of an area.

6.2 Notify user groups of restoration goals, chemical treatments, and future management. User groups should be notified of chemical treatment schedules and advised to use alternative recreational areas. Details of transplants should be made public by inclusion in California Department of Fish and Game archives and publication in California Fish and Game if deemed appropriate by the editors. User groups should also be informed regarding the long-term restoration goal of expanding Paiute cutthroat trout downstream to Silver King Canyon, as well as the opportunity for California Department of Fish and Game to establish a recreational fishery.

III. IMPLEMENTATION SCHEDULE

The implementation schedule that follows lists the actions and estimated costs for the recovery program for the Paiute cutthroat trout. It is a guide for meeting the recovery goals outlined in this plan. Parties with authority, responsibility, or expressed interest to implement a specific recovery action are identified in the Implementation Schedule. The listing of a party in the Implementation Schedule does not require, nor imply a requirement, that the identified party has agreed to implement the actions or to secure funding for the implementing the actions. However, parties willing to participate may benefit by being able to show in their own budgets that their funding request is for a recovery action identified in an approved recovery plan and is therefore considered a necessary action for the overall coordinated effort to recover Paiute cutthroat trout. Also, section 7(a)(1) of the Endangered Species Act directs all Federal agencies to utilize their authorities in furtherance of the purposes of the Endangered Species Act by carrying out programs for the conservation of threatened and endangered species.

In the implementation schedule, actions are arranged in priority order. The assigned priorities are defined as follows:

Priority 1 - An action that **must** be undertaken to prevent extinction or to prevent the species from declining irreversibly in the **foreseeable** future.

Priority 2 - An action that must be taken to prevent a significant decline in population or habitat quality, or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to meet the recovery objective.

Key to Acronyms used in the Implementation Schedule:

Agencies

CDFG	=	California Department of Fish and Game
FS	=	U.S. Forest Service
FWS	=	U.S. Fish and Wildlife Service
*	=	Primary responsible partner: a partner likely to take the lead, or have an especially large role in implementing a recovery action.

Streams

CC	=	Cabin Creek
NFCC	=	North Fork Cottonwood Creek
SHC	=	Sharktooth Creek
SKC	=	Silver King Creek
STC	=	Stairway Creek

† Continued implementation of action expected to be necessary after delisting.

‡ Task expected to be necessary until delisting of species.

Implementation Schedule for the Draft Revised Recovery Plan for the Paiute Cutthroat Trout										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties	Total Cost ($1,000's) 2004-2013	Cost Estimates ($1,000's) by Fiscal Year				
						FY 04	FY 05	FY 06	FY 07	FY 08
1	1	Remove nonnative fish from SKC downstream from Llewellyn Falls to barriers in SKC Canyon	3	CDFG* FS FWS	80 10 10	30 4 4	25 3 3	25 3 3		
1	2	Reintroduce Paiute cutthroat trout into renovated stream reaches in historic habitat in lower SKC	5	CDFG* FS	38 2				7.6 0.4	7.6 0.4
1	3.2.7	Construct a second barrier on lower NFCC	3	FS*	105		35	35	35	
1	4.1.2	Prevent exotic fish introductions into Paiute cutthroat trout waters	Ongoing†	CDFG	20	2	2	2	2	2
Priority 1 actions subtotal					265	40	68	68	45	10
2	3.1.1	Institute a habitat monitoring program	Periodic‡	FS*	Unknown					
2	3.1.2	Monitor and manage amount of recreational trail and campsite use adjacent to occupied habitats in SKC watershed	Ongoing†	FS*	10	1	1	1	1	1
2	3.1.3	Protect Paiute cutthroat trout habitat from effects of grazing in SKC watershed	Periodic†	FS* FWS	Unknown					

Implementation Schedule for the Draft Revised Recovery Plan for the Paiute Cutthroat Trout										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties	Total Cost ($1,000's) 2004-2013	Cost Estimates ($1,000's) by Fiscal Year				
						FY 04	FY 05	FY 06	FY 07	FY 08
2	3.1.4	Conduct periodic surveys in SKC to detect reinvasion by beavers	Periodic‡	FS* CDFG	2 0.5					1 0.25
2	3.1.5	Remove beavers from SKC watershed if detected and dismantle dams and lodges if any are built	Periodic†	CDFG* FS	Unknown					
2	3.2.1	Conduct periodic habitat surveys at NFCC	Periodic‡	FS*	Unknown					
2	3.2.2	Establish off-highway vehicle barriers in NFCC at existing and potential access points	Ongoing‡	FS*	10	1	1	1	1	1
2	3.2.3	Protect Paiute cutthroat trout habitat in NFCC from effects of grazing	Periodic†	FS* FWS	Unknown					
2	3.2.4	Set and enforce dispersed and developed recreational use limits in NFCC	Ongoing†	FS*	Unknown					
2	3.2.5	Conduct periodic surveys in NFCC to detect reinvasion by beavers	Periodic‡	FS* CDFG	0.325 0.325					0.162 0.162
2	3.2.6	Remove beavers in NFCC if detected and dismantle dams and lodges if any are built.	Periodic†	CDFG* FS	Unknown					

Implementation Schedule for the Draft Revised Recovery Plan for the Paiute Cutthroat Trout										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties	Total Cost ($1,000's) 2004-2013	Cost Estimates ($1,000's) by Fiscal Year				
						FY 04	FY 05	FY 06	FY 07	FY 08
2	3.2.8	Develop and implement solutions for other identified habitat problems in NFCC	Periodic	FS* FWS	Unknown					
2	3.3.2	Protect Paiute cutthroat trout habitat from effects of grazing in CC	Periodic†	FS* FWS	Unknown					
2	4.1.1	Maintain a seasonal guard in upper SKC	Ongoing†	CDFG* FS	10 10	1 1	1 1	1 1	1 1	1 1
2	4.3.3	Assess integrity of barriers in SKC	Ongoing‡	FS* CDFG	4 3.5	0.4 0.35	0.4 0.35	0.4 0.35	0.4 0.35	0.4 0.35
2	4.3.4	Mix populations in SKC as necessary to maintain genetic diversity	5	CDFG* FS FWS	8 1 1				1.6 0.2 0.2	1.6 0.2 0.2
2	4.4.2	Evaluate the potential for occurrence of hybrid trout in NFCC	Ongoing‡	CDFG* FS FWS	3 1 1	0.3 0.1 0.1	0.3 0.1 0.1	0.3 0.1 0.1	0.3 0.1 0.1	0.3 0.1 0.1
2	4.4.3	Assess integrity of barriers in NFCC	Ongoing‡	FS* CDFG	2 1.75	0.2 0.17	0.2 0.17	0.2 0.17	0.2 0.17	0.2 0.17
2	4.4.4	Mix populations in NFCC as necessary to maintain genetic diversity	1	CDFG* FS FWS	Unknown					
2	4.5.4	Mix populations in STC, SHC, and CC as necessary to maintain genetic diversity	Periodic	CDFG* FS FWS	Unknown					
Priority 2 actions subtotal					69.4	5.63	5.63	5.63	7.63	9.2

Implementation Schedule for the Draft Revised Recovery Plan for the Paiute Cutthroat Trout										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties	Total Cost ($1,000's) 2004-2013	Cost Estimates ($1,000's) by Fiscal Year				
						FY 04	FY 05	FY 06	FY 07	FY 08
3	3.1.6	Develop and implement solutions for other identified problems in SKC	Periodic	CDFG* FS* FWS	1.6 1.6 1.6			0.53 0.53 0.53		
3	3.3.1	Conduct periodic habitat surveys in STC, SHC, and CC	Periodic‡	FS*	25		12.5	12.5		
3	3.3.3	Develop and implement solutions for other identified habitat problems in STC, SHC, and CC	Periodic	CDFG* FS FWS	0.33 0.33 0.33					0.165 0.165 0.165
3	4.2	Review existing laws and regulations and propose necessary changes	Ongoing	CDFG*	2	1				
3	4.3.1	Monitor abundance and age class composition in SKC	Ongoing‡	CDFG* FS	70 10	7 1	7 1	7 1	7 1	7 1
3	4.3.2	Evaluate the potential for occurrence of hybrid trout in SKC	Ongoing‡	CDFG* FS FWS	9 1 1	0.9 0.1 0.1	0.9 0.1 0.1	0.9 0.1 0.1	0.9 0.1 0.1	0.9 0.1 0.1
3	4.3.5	Develop and implement actions, as needed, to protect genetic integrity in SKC	Periodic	CDFG* FWS FS	Unknown					
3	4.4.1	Monitor abundance and age class composition in NFCC	Ongoing‡	CDFG* FS	30 10	3 1	3 1	3 1	3 1	3 1
3	4.4.5	Develop and implement actions, as needed, to protect genetic integrity in NFCC	Periodic	CDFG* FWS FS	Unknown					

Implementation Schedule for the Draft Revised Recovery Plan for the Paiute Cutthroat Trout										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties	Total Cost ($1,000's) 2004-2013	Cost Estimates ($1,000's) by Fiscal Year				
						FY 04	FY 05	FY 06	FY 07	FY 08
3	4.5.1	Monitor abundance and age class composition in STC, SHC, and CC	Periodic‡	CDFG* FS	15 25		12.5	5 12.5		
3	4.5.2	Evaluate the potential for occurrence of hybrid trout composition in STC, SHC, and CC	Periodic‡	CDFG* FS	4 1			1.33 0.33		
3	4.5.3	Assess integrity of barriers in STC, SHC, and CC	Periodic‡	CDFG* FS	0.75 0.5			0.25 0.166		
3	4.5.5	Develop and implement actions, as needed, to protect genetic integrity in STC, SHC, and CC	Periodic	CDFG* FWS FS	Unknown					
3	4.6	Explore additional out-of-basin locations	Ongoing	CDFG* FWS FS	Unknown					
3	5.1	Develop long-term conservation plan	2	CDFG* FWS FS	12					
3	5.2	Develop a conservation agreement	2	CDFG* FWS FS	Unknown					
3	6.1	Manufacture and post informational signs	4	FS*	4	1	1	1	1	

Implementation Schedule for the Draft Revised Recovery Plan for the Paiute Cutthroat Trout										
Priority Number	Action Number	Action Description	Action Duration (Years)	Responsible Parties	Total Cost ($1,000's) 2004-2013	Cost Estimates ($1,000's) by Fiscal Year				
						FY 04	FY 05	FY 06	FY 07	FY 08
3	6.2	Notify user public of restoration goals, chemical treatments, and future management	5	CDFG* FS FWS	6 1 1	1.5 0.2 0.2	1.5 0.2 0.2	1.5 0.2 0.2	1.5 0.2 0.2	 0.2 0.2
Priority 3 actions subtotal					224.05	17	41	49.68	16	14

Total Estimated Cost of Recovery: $558,450 + additional costs that cannot be estimated at this time.

Total costs of recovery for ongoing and periodic tasks are calculated based on the projected 10-year period to delisting. Costs of certain tasks (i.e., those relating to developing and implementing additional actions to protect genetic integrity, developing solutions to future land use conflicts, protecting habitat from impacts due to potential future alteration of grazing management, exploring additional out-of-basin locations, removal of beavers that may colonize Paiute cutthroat trout habitat, and developing a conservation agreement) cannot be estimated because their scope and the need to implement them will be dependent on future events or obtaining additional information.

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APPENDIX A. Summary of General Aquatic Wildlife System (GAWS) Survey Locations, Sediment Sampling, and Macroinvertebrate Sampling

Table A1. Summary of GAWS station site characteristics (Modified from Duff 1985).

Stream	Station	Elevation (m)	Gradient	Channel Width (m)	Water Depth (m)	Riffle/Pool Ratio	Reach Length (m)
Silver King	S1:610	2457	2.0	7.92	0.26	40/60	150
Silver King	S2:640	2463	2.5	9.79	0.25	24/76	374
Silver King	S3:641	2465	2.0	8.10	0.22	70/30	296
Silver King	S4:700	2454	2.0	11.4	0.14	12/88	150
Silver King	S5:725	2484	1.0	7.4	0.17	20/80	150
Silver King	S6:738	2486	2.0	9.58	0.24	52/48	150
Silver King	S6A:745	2488	2.0	8.36	0.17	45/55	150
Silver King	S7:775	2499	2.0	5.72	0.16	31/69	150
Silver King	S8:813	2505	2.5	6.42	0.12	15/85	150
Bull Canyon	S1:040	2463	2.5	5.64	0.24	50/50	150
Bull Canyon	S2:100	2475	4.5	6.86	0.095	33/67	150
Fly Valley	S1:500	2646	3.0	2.76	0.82	20/80	150
Four Mile	S1:250	2560	2.5	3.27	0.15	17/83	300
Coyote	S1:400	2484	1.0	2.9	0.10	60/40	150
Coyote	S2:467	2489	1.5	3.8	0.84	60/40	150
Coyote	S3:500	2492	1.0	2.76	0.12	60/40	150
Coyote	S4:542	2498	2.0	2.56	0.11	55/45	150
Corral	S1:571	2525	2.5	2.5	0.14	55/45	150
Corral	S2:574	2532	3.0	2.46	0.33	40/60	240

Five transects were measured within each reach. Channel (bankfull) width is the average width of all five transects. Water depth is the average water depth taken over all 5 transects (15 to 20 depth measurements were taken at each of the 5 transects,75-100 measurements).

Table A2. Summary of sediment samples collected in 1984 and 1990 (Modified from Duff 1991).

Stream	Station	Percent Fines Passing Sieve			
		>6.35 mm	>0.84 mm	>0.21 mm	<6.35 mm
Silver King	S1:610	---	---	---	---
Silver King	S2:640	64.3 (60.3)	21.8 (20.4)	13.9 (19.3)	35.7 (39.7)
Silver King	S3:641	61.8 (53.4)	23.1 (30.8)	15.1 (15.8)	38.2 (46.6)
Silver King	S4:700	57.0 (61.5)	20.2 (21.9)	22.8 (16.6)	43.0 (38.5)
Silver King	S5:725	57.3 (59.0)	25.5 (24.7)	17.2 (16.3)	42.7 (41.0)
Silver King	S6:738	59.3 (68.6)	24.7 (15.7)	16.0 (15.7)	40.7 (31.4)
Silver King	S6A:745	---	---	---	---
Silver King	S7:775	64.8 (57.6)	25.6 (28.0)	9.6 (14.4)	35.2 (42.4)
Silver King	S8:813	60.0 (64.2)	29.0 (25.5)	11.0 (10.6)	40.0 (35.8)
MEAN		**60.6 (60.7)**	**24.3 (23.8)**	**15.1 (15.5)**	**39.4 (39.3)**
Bull Canyon	S1:040	62.9 (61.0)	20.9 (23.5)	16.2 (15.5)	37.1 (39.0)
Bull Canyon	S2:100	---	---	---	---
Fly Valley	S1:500	62.9 (67.9)	24.3 (26.7)	12.8 (5.4)	37.1 (32.1)
Four Mile	S1:250	69.6 (72.4)	20.4 (18.5)	10.0 (9.1)	30.4 (27.6)
Coyote	S1:400	---	---	---	---
Coyote	S2:467	32.2 (41.0)	38.3 (39.5)	29.5 (19.5)	67.8 (59.0)
Coyote	S3:500	44.5 (52.1)	36.5 (31.1)	19.0 (16.8)	55.5 (47.9)
Coyote	S4:542	---	---	---	---
MEAN		**38.4 (46.6)**	**37.4 (35.3)**	**24.3 (18.2)**	**61.7 (53.5)**
Corral	S1:571	51.8 (51.0)	30.4 (32.0)	17.8 (17.0)	48.2 (49.0)
Corral	S2:574	45.7 (46.9)	27.3 (36.0)	27.0 (17.1)	54.3 (53.1)
MEAN		**48.8 (49.0)**	**28.9 (34.0)**	**22.4 (17.1)**	**51.3 (51.1)**

Values outside parentheses represent 1990 data and values inside parentheses represent data from 1984.

Table A3. Summary of macroinvertebrate diversity index (DAT) ratings from 1984, 1987, and 1990. (Modified from Mangum 1991)

Stream	Station	Channel Type	DAT 1984	DAT 1987	DAT 1990
Silver King	S1:610	C3	---	---	---
Silver King	S2:640	C3	24.3	17.8	25.0
Silver King	S3:641	C3	21.7	12.3	20.2
Silver King	S4:700	C3	20.1	19.2	21.1
Silver King	S5:725	C3	17.4	20.5	20.9
Silver King	S6:738	C3	17.5	13.8	17.5
Silver King	S6A:745	C3	---	---	---
Silver King	S7:775	B2/B3	15.6	19.1	20.0
Silver King	S8:813	C3	11.2	18.3	20.3
Bull Canyon	S1:040	C3	---	---	---
Bull Canyon	S2:100	B2	17.8	21.2	---
Fly Valley	S1:500	B2/C2	20.8	17.5	---
Four Mile	S1:250	C3	19.8	21.1	16.4
Coyote	S1:400	C6	14.9	17.1	---
Coyote	S2:467	C3	---	---	---
Coyote	S3:500	C6	17.3	14.9	---
Coyote	S4:542	C3	---	---	---
Corral	S1:571	C3	17.9	18.8	---
Corral	S2:574	C3	---	---	---

Scale	DAT	Standing Crop	BCI
Excellent	18 - 26	4.0 - 12.0	> 90
Good	11 - 17	1.6 - 4.0	75 - 89
Fair	6 - 10	0.6 - 1.5	< 75
Poor	0 - 5	0.0 - 0.5	< 75

Table A4. Summary of macroinvertebrate standing crop data from 1984, 1987, and 1990. (Modified from Mangum 1991)

Stream	Station	Channel Type	Standing Crop g/m^2 1984	Standing Crop g/m^2 1987	Standing Crop g/m^2 1990
Silver King	S1:610	C3	---	---	---
Silver King	S2:640	C3	5.6	1.3	1.1
Silver King	S3:641	C3	3.1	0.9	0.5
Silver King	S4:700	C3	1.0	0.7	1.1
Silver King	S5:725	C3	2.5	4.0	0.5
Silver King	S6:738	C3	2.1	0.8	0.6
Silver King	S6A:745	C3	---	---	---
Silver King	S7:775	B2/B3	1.6	1.1	2.6
Silver King	S8:813	C3	0.9	1.0	1.0
Bull Canyon	S1:040	C3	---	---	---
Bull Canyon	S2:100	B2	0.5	0.8	---
Fly Valley	S1:500	B2/C2	1.3	0.5	---
Four Mile	S1:250	C3	1.8	2.5	1.2
Coyote	S1:400	C6	1.4	1.8	---
Coyote	S2:467	C3	---	---	---
Coyote	S3:500	C6	1.1	1.6	---
Coyote	S4:542	C3	---	---	---
Corral	S1:571	C3	1.3	1.6	---
Corral	S2:574	C3	---	---	---

Scale	DAT	Standing Crop	BCI
Excellent	18 - 26	4.0 - 12.0	> 90
Good	11 - 17	1.6 - 4.0	75 - 89
Fair	6 - 10	0.6 - 1.5	< 75
Poor	0 - 5	0.0 - 0.5	< 75

Table A5. Summary of macroinvertebrate Biotic Condition Index (BCI) ratings from 1984, 1987, and 1990. (Modified from Mangum 1991)

Stream	Station	Channel Type	BCI 1984	BCI 1987	BCI 1990	BCI Desired
Silver King	S1:610	C3	---	---	---	---
Silver King	S2:640	C3	96	100	100	110
Silver King	S3:641	C3	96	100	100	110
Silver King	S4:700	C3	93	96	100	110
Silver King	S5:725	C3	100	100	98	110
Silver King	S6:738	C3	91	100	89	110
Silver King	S6A:745	C3	---	---	---	---
Silver King	S7:775	B2/B3	88	100	100	110
Silver King	S8:813	C3	93	98	100	110
Bull Canyon	S1:040	C3	88	---	---	---
Bull Canyon	S2:100	B2	---	98	---	110
Fly Valley	S1:500	B2/C2	96	100	---	105
Four Mile	S1:250	C3	106	110	91	115
Coyote	S1:400	C6	93	96	---	110
Coyote	S2:467	C3	93	---	---	110
Coyote	S3:500	C6	98	88	---	110
Coyote	S4:542	C3	---	96	---	110
Corral	S1:571	C3	94	86	---	105
Corral	S2:574	C3	---	---	---	---

Scale	DAT	Standing Crop	BCI
Excellent	18 - 26	4.0 - 12.0	> 90
Good	11 - 17	1.6 - 4.0	75 - 89
Fair	6 - 10	0.6 - 1.5	< 75
Poor	0 - 5	0.0 - 0.5	< 75

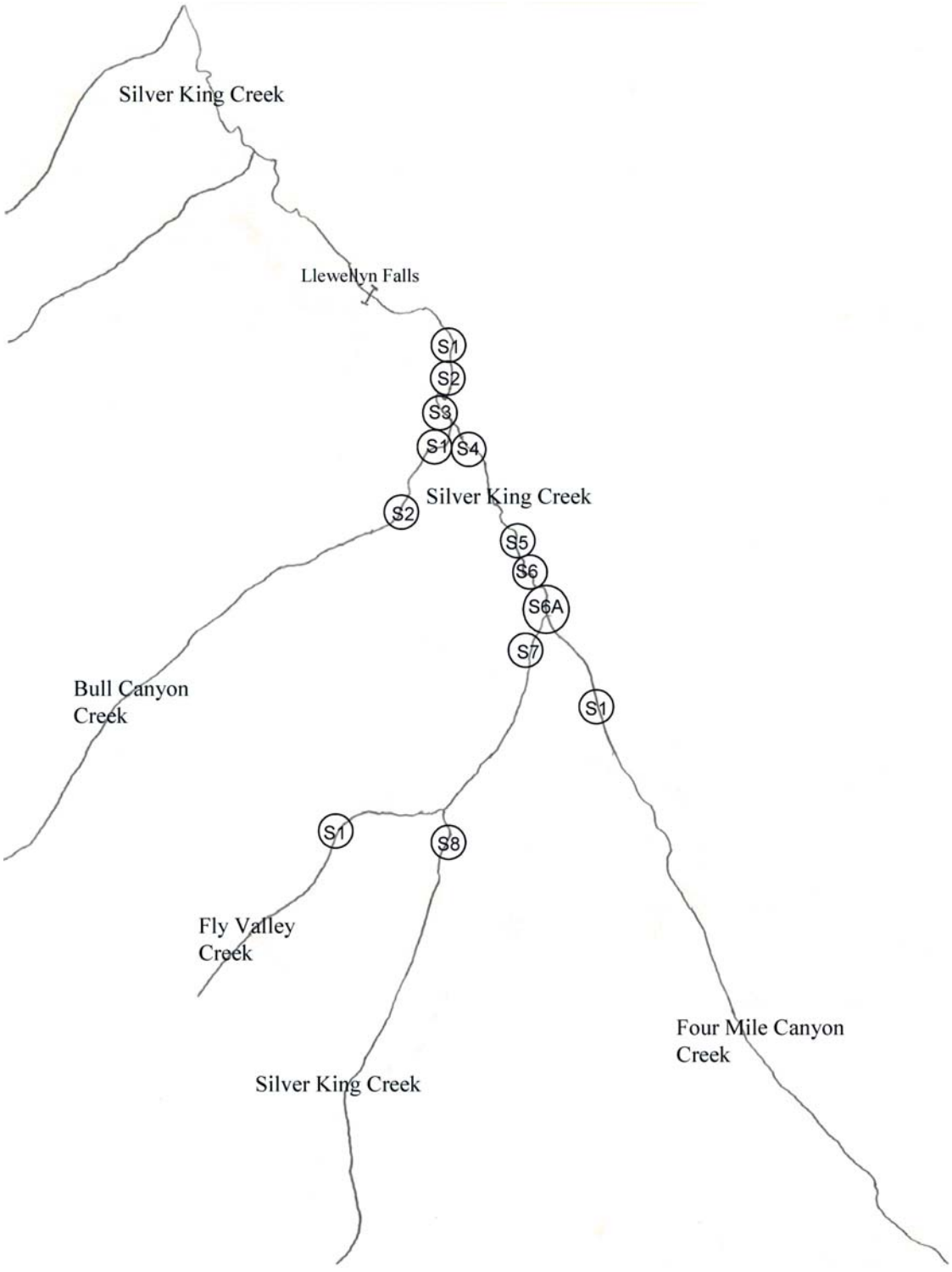

Figure A1. Location of GAWS stations on Silver King, Four Mile Canyon, Fly Valley, and Bull Canyon Creeks, Alpine County, California.

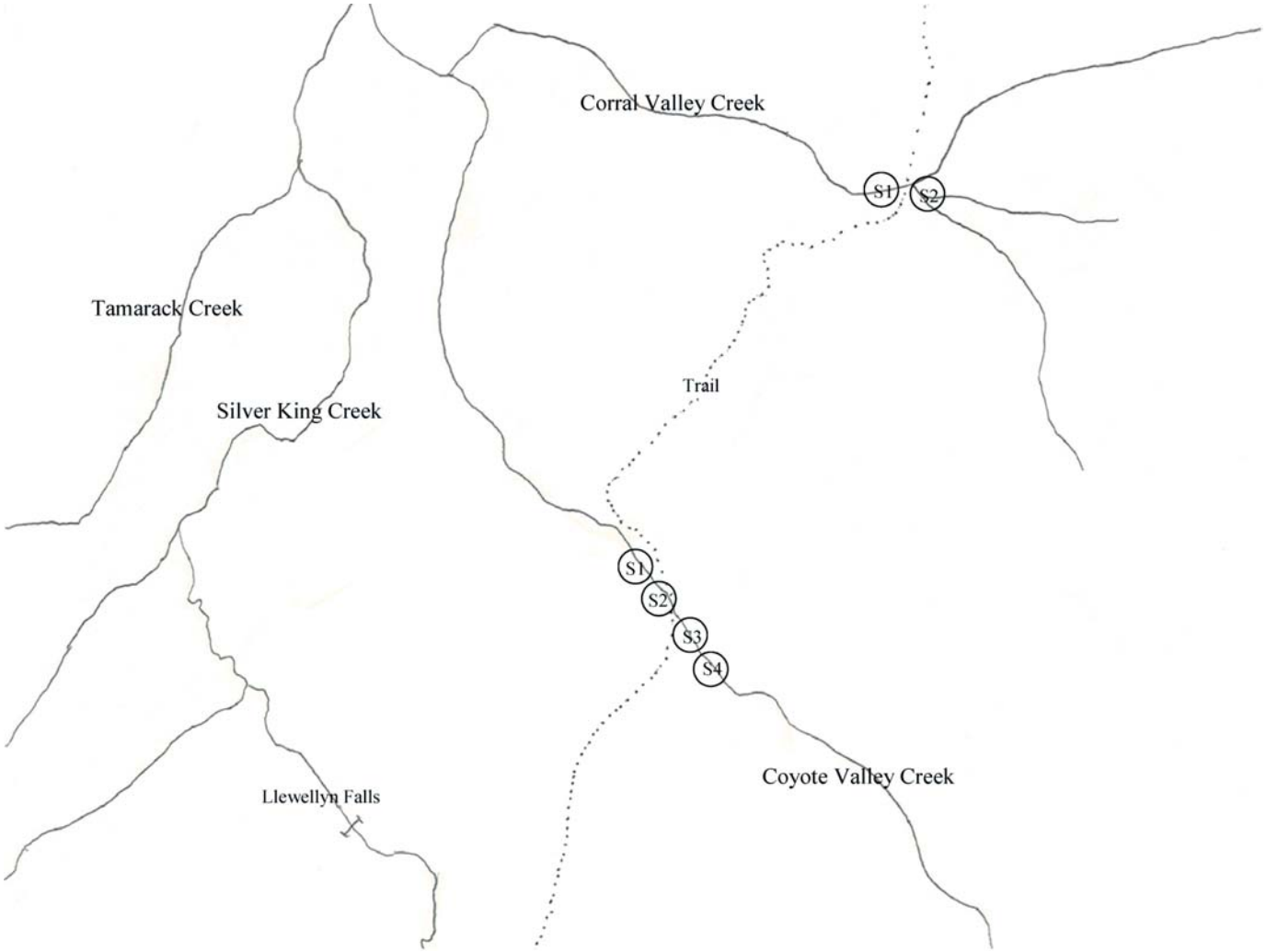

Figure A2. Location of GAWS stations on Corral Valley and Coyote Valley Creeks, Alpine County, California.

APPENDIX B. Summary of Threats and Recommended Recovery Actions.

LISTING FACTOR	THREAT	RECOVERY CRITERIA	RECOVERY ACTION NUMBERS
A	Streambank degradation from recreational activities	3	3.1.1, 3.1.2, 3.1.6, 3.2.1, 3.2.2, 3.2.4, 3.3.3
A	Streambank degradation from cattle grazing	3	3.1.1, 3.1.3, 3.1.6, 3.2.1, 3.2.3, 3.2.8, 3.3.1, 3.3.2, 3.3.3
A	Degradation of water quality and spawning substrates by beavers	3	3.1.1, 3.1.4, 3.1.5, 3.1.6, 3.2.1, 3.2.5, 3.2.6, 3.2.8, 3.3.1, 3.3.3
B	Unregulated angling	2, 4	3.1.6, 3.2.4, 3.2.8, 3.3.1, 3.3.3, 4.1.1, 4.2, 6.1, 6.2
C	Natural predators [not currently significant]	NA	
C	Fungal infections	2	4.3.1, 4.4.1, 4.5.1
D	Potential budgetary constraints on agency commitment to recovery actions	1, 2, 3, 4, 5	4.2, 5.1, 5.2
E	Hybridization and competition with introduced trout	1, 2, 4	1, 2, 4.1.1, 4.1.2, 4.3.2, 4.3.5, 4.4.2, 4.4.5, 4.5.2, 4.5.5
E	Need for fish barriers to prevent upstream migration of introduced trout	1, 2, 4	1, 2, 3.2.7, 4.3.3, 4.3.5, 4.4.3, 4.4.5, 4.5.3, 4.5.5
E	Human introduction of trout	1, 2, 4	1, 2, 4.1.1, 4.1.2, 4.2, 4.3.5, 4.4.5, 4.5.5, 6.1, 6.2
E	Vulnerability to catastrophic events due to limited distribution	2, 3, 4	2, 4.3.1, 4.3.4, 4.4.1, 4.4.4, 4.5.1, 4.5.4, 4.6

Listing Factors:
A. The Present or Threatened Destruction, Modification, or Curtailment Of Its Habitat or Range
B. Overutilization for Commercial, Recreational, Scientific, Educational Purposes (not a factor)
C. Disease or Predation
D. The Inadequacy of Existing Regulatory Mechanisms
E. Other Natural or Manmade Factors Affecting Its Continued Existence

Recovery Criteria:

1. All nonnative salmonids are removed in Silver King Creek and its tributaries downstream of Llewellyn Falls to fish barriers in Silver King Canyon.
2. A viable population occupies all historic habitat in Silver King Creek and its tributaries downstream of Llewellyn Falls to fish barriers in Silver King Canyon.
3. Paiute cutthroat trout habitat is maintained in all occupied streams.
4. The refuge populations in Corral and Coyote Creeks, Silver King Creek, and tributaries above Llewellyn Falls as well as out-of-basin populations are maintained as refugia and are secured from the introduction of other salmonid species.
5. A long-term conservation plan and conservation agreement are developed, which will be the guiding management documents once Paiute cutthroat trout are delisted.